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Vol. 60 MAY, 1933 No. 5

Bulletin

of the

Torrey Botanical Club

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Published for the Club monthly except
July, August, and September
by
GEORGE BANTA PUBLISHING COMPANY, MENASHA, WISCONSIN
Subscription price $6.00 per year
Entered as Second Class Matter at the Post Office at Menasha, Wisconsin
Accepted for mailing at special rate of postage provided for in the act of February 28, 1925, embodied in paragraph 4, section 412, P. L. and R., authorized July 23, 1928.

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Bulletin. Established 1870. Monthly, except during July, August, and September. Price, $6.00 a year; single numbers 75 cents. Of former volumes, only 24–56 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Dr. B. O. Dodge, New York Botanical Garden, Bronx Park, New York, N.Y. The editors may accept papers up to 20 pages in length, with illustrations and tabular matter generally not exceeding twenty per cent of that amount. Longer and more copiously illustrated papers, however, may be published if the excess pages, illustrations, and tabular matter are paid for by the contributors.

Torreya. Bimonthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Mr. George T. Hastings, Editor, 2587 Sedgwick Ave., New York, N. Y.

Memoirs. Occasional, established 1889.

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Reprints. Contributors of articles accepted for publication in the BULLETIN should order reprints, if desired, when they return galley proofs to the editor. They may be ordered through the editor from the George Banta Publishing Company, the contributor paying for all his reprints. A schedule of rates is sent with galley proof.

Crops and civilizations[1]

E. D. Merrill

Modern anthropologists in general admit that the beginnings of culture in the history of man took place near the close of the Tertiary. In geologic time this represents somewhere in the neighborhood of 1,000,000 years, but man's even more primitive history probably long antedates this period. At the distant time of 1,000,000 years, man's whole existence was centered on the hunt for food, but even then crude stone implements were in use. For most of the period indicated, man was a primitive nomad. Progress was very slow, and no relatively great steps were made until toward the end of this 1,000,000-year period. Just when various advances were made we do not know, but between 20,000 and 30,000 years ago such innovations as the use of fire, construction of shelters, wearing of clothing, development of sculpture, utilization of bodily ornaments, practice of ceremonies, and formal burial of the dead were established at least among the more progressive peoples of that time. Still man was even then essentially a roving hunter.

Some time approximating 8,000 to 10,000 years ago, there occurred an economic revolution of the greatest significance to man. This was the establishment of agriculture, the domestication of plants and animals, leading to a dependable food supply and thus the formation of permanent settlements, and the development of sedentary life. This economic revolution with its resulting division of labor gave man the opportunity to devote time, energy and attention to other things than merely providing daily food. With agriculture once established, the growth of urban communities, and marked advances in social, civil, political, and ecclesiastical organization, became possible. Thus soon following the beginning of the neolithic age about 10,000 B.C. came the establishment of ceramic industry, the manufacture of textiles, the use of copper, gold, meteoric iron, and, eventually, in the bronze and early iron ages, the development of metallurgy, followed in due time in man's advance by the invention of writing, and other innovations with which we are all more or less familiar.

It seems probable that the domestication of animals preceded the do-

[1] Retiring vice-presidential address, section G (Botanical Sciences) A.A.A.S. at its joint meeting with the Botanical Society of America, American Phytopathological Society, American Society of Plant Physiologists, and Mycological Society of America, Atlantic City, December 28, 1932.

[The Bulletin for April (60: 241–322) was Issued April 1, 1933.]

mestication of plants, and that for a time the more advanced peoples were those who tended their herds. The establishment of permanent agriculture—that is the cultivation of plants—was, however, the great forward step that provided the opportunity for the development of the higher civilizations. Long before the dawn of recorded history, agriculture was a thoroughly established art in various parts of the world, and for untold ages before plants were ever cultivated, man gathered edible seeds, fruits and tubers from wild growing plants, even as primitive peoples do at the present time. We can gain some perspective if we compare the advances made in the past 100 years with those of the past 2,000 years, and again compare man's accomplishments during the past 5,000 years with those of the preceding 15,000 years, and the million or more years preceding the dawn of civilization. The period of great enlightenment has occupied only a very small fraction of man's existence.

The importance of the establishment of agriculture in relation to the progress of mankind cannot be overlooked. It was probably the most significant single advance in man's development. It should be borne in mind that at the dawn of recorded history every basic food plant now grown was already in cultivation and every domestic animal was already in domestication. It is true that modern man has greatly improved both cultivated plants and domesticated animals, but he has added not a single species basic to his food supply to those domesticated by his remote ancestors. We thus owe a tremendous debt to numerous unrecorded individuals, who in remote ages, long before man prepared permanent records, selected from the wild and adapted to their needs through domestication the plants and animals which gave them a permanent food supply and hence paved the way to the development of civilization. So long ago did this happen that these pioneer agriculturists were forgotten long before recorded history commences, for the beginnings of agriculture among all early peoples are lost in mythology. Whether in Mesopotamia or Egypt, in Greece or Rome, in China or among the American Indians, usually the supernatural was invoked to explain this or that basic crop, be it wheat, or barley, or maize, or rice. Among the Egyptians wheat was considered to be the gift of Osiris; among the Romans the gift of Ceres; and we perpetuate this idea today in our common word *cereal*.

It is worthy of more than passing notice that those regions that have actually produced most of our basic food plants and domesticated animals are comparatively restricted, and that it is in these same restricted areas that the ancient higher civilizations developed. All of North America north of Mexico, all of Australia, much of South America, Africa, Europe, and Asia, have contributed little or nothing, and the extreme tropical and

cooler temperate regions have been rather barren fields in originating basic food plants. The important centers of origin of both cultivated plants and domesticated animals have in general been those regions with a Mediterranean type of climate, with no great extremes of heat or cold, and with a reasonably ample and well distributed rainfall or where irrigation could easily be developed; in other words, regions with equable climates. In America the outstanding centers were the highlands of Mexico and of Peru, Bolivia and Ecuador, with secondary centers in Central America and Yucatan; and the food plants basic to these early American civilizations were maize, potato, sweet potato, lima bean, our common field beans, and various indigenous fruits and vegetables. In Eurasia may be listed the Mediterranean basin, Asia Minor, and contiguous areas to the east, limited areas in central Asia, and in parts of India and China. For the Mediterranean basin, Asia Minor and southeastern Asia, the basic food plants were the common cereals, wheat, barley, rye, oats, and certain fruits and vegetables, with such domesticated animals as cattle, horses, swine, sheep and goats, while for India and China perhaps the most important cereal was rice, although others such as millet, sorghum, ragi, coix, and, at an early date, barley and wheat received from the west, with yams and various vegetables and fruits, were used. These limited regions which produced the first, and for that matter most of the cultivated plants and domesticated animals, comprising only a very small fraction of the land surface of the earth, also, significantly, harbored the earliest civilizations. The rest of the world counted for practically nothing, either in the production of basic foods or in providing the rudiments of culture. Among the ancient centers of civilization, only Mesopotamia and Egypt were not the actual homes of the plants on which their life was based. But both regions were contiguous to points of origin of important foods, so both borrowed their agricultural crops from these neighboring lands.

Transportation, however, seldom went farther than to the nearest neighbors. Each ancient center of civilization was also the center for a small group of basic plants which were little known beyond the borders and totally unknown across either ocean. Up to about 1500 A.D. the continental boundaries as between the eastern and western hemispheres governed the dissemination of agricultural plants and animals, and very few cultivated species, none of first importance from the standpoint of food supply, transcended the boundaries of the two hemispheres.

This point leads to another phase of the subject which has not been given the consideration it deserves particularly among anthropologists and ethnologists. This is the vital bearing that this matter has on the origin of early American civilizations. Some authors have assumed and stoutly de-

fended the thesis that the early American civilizations were derived from those of Europe and Asia. Some of the claims are fanciful in the extreme, apparently based largely on preconceived ideas, while others are more logical and have been seriously presented. The Atlantis theory has its ardent supporters, some even going to the extreme of deriving both the Mediterranean and early American cultures from the mythical Atlantis. Even more fanciful are the theories proposed whereby early American civilizations are explained on the basis of the existence of the mythical continent of Mu in the Pacific basin, thus permitting the transmission of Asiatic cultures to America. Others explain certain similarities between the ancient civilizations of Mexico, Peru and Central America and those of Eurasia by various contacts with Europe or Asia, whereby the Old World cultures were transmitted to America. The suggestions, or propositions, include Japanese, Chinese, Greek, Latin, Welsh, Egyptian, Mesopotamian and Polynesian contacts, and some even invoke the lost tribes of Israel. To many of these suggestions serious students of anthropology and ethnology give little or no credence. However, some, apparently representative of that school who would trace all great innovations to a single original source, support the Eurasian-American contact idea on the assumption that architecture, hieroglyphic writing, ecclesiastic, political and civil organizations, etc., either did not or could not originate independently, but having been invented by one people in one place, the art or the idea was transmitted to other peoples by direct or indirect contacts.

Proponents of the Eurasian-American contact theory have rather strangely overlooked the bearing of agriculture on the subject, so let us examine it for them. The closing sentence in de Candolle's classical work on the origin of cultivated plants is as follows: "In the history of cultivated plants I have noticed no traces of communications between the peoples of the old and the new worlds before the discovery of America by Columbus." The fact was so obvious to him, and should be so obvious to anyone who will seriously examine the data, that he did not consider it even necessary to amplify the statement further in connection with any supposed Eurasian influences on early American civilizations.

The number of species of basic cultivated food plants and domesticated animals is not great. For most of them we have very definite information as to the general regions in which they originated. A few cultivated plants have never been found in a wild state, one of the most notable being maize or Indian corn. Others have been so altered in cultivation that we can only approximate what the wild form probably was, as in the case of wheat, and in various vegetables such as those in the genus *Brassica*. If one tabulates the few score species involved as to places of origin, one obtains

a very graphic representation of the truth of de Candolle's statement quoted above. The mere statement that American agriculture, the basis of early American civilizations, was established and maintained until after 1500 absolutely and wholly on native American plants and animals, gains further weight when it is realized that these American basic foods are for the most part produced by plants generically distinct from the food-producing plants of the Old World.

The basic Eurasian food plants are wheat, rye, barley, oats, rice, millet, Italian millet, sorghum, pearl millet, ragi, teff, coix, buckwheat, turnip, cabbage, mustard, radish, beet, parsnip, carrot, onion, leek, garlic, shallot, spinach, egg-plant, lettuce, endive, salsify, celery, globe artichoke, asparagus, pea, cow-pea, chick-pea, pigeon-pea, lentil, soy-bean, broad-bean, hyacinth-bean, asparagus-bean, green-gram, taro, yam, apple, pear, plum, cherry, wine or raisin grape, apricot, peach, prune, olive, fig, almond, persimmon, quince, pomegranate, melon, watermelon, cucumber, sugarcane, banana, cocoanut, orange, lime, lemon, pomelo, date, mango, breadfruit, jak-fruit, rambutan, litchi, longan, lansone, mangosteen and others. The domestic animals include all breeds of cattle, horses, water buffaloes, yaks, sheep, goats, swine, ducks, geese, hens and pigeons. None was known in America before the European contacts following Columbus' voyage in 1492.

The agricultural products basic to American civilizations are fewer than those basic to Eurasian civilizations. They include a single cereal, but this, maize or Indian corn, a most important one; also the potato, sweet potato, lima bean, our common garden and field beans, tomato, pepper, Jerusalem artichoke, sunflower, squash, pumpkin, peanut, quinoa, cassava, arrowroot, chayote, papaya, avocado, cacao, cashew, pineapple, custard apple, sour sop, cherimoya, sapote, sapodilla and others. The domesticated animals were peculiarly few, the llama and alpaca in South America, the turkey in Mexico. None of these was known in Europe or Asia before the voyages of Columbus and of Magellan.

In the light of various theories proposed, postulating the derivation of early American civilizations on the basis of Eurasian contacts and the dissemination of Eurasian ideas and inventions to the less advanced American aborigines, what interpretations shall be placed on the data as presented above? To those who postulate a mythical Atlantis as the ancient center of civilization from which the Mediterranean and early American cultures were derived, for it must be assumed that any highly civilized ancient center must have had a highly developed agriculture, what could have been the agriculture of Atlantis that transmitted to its assumed descendants in the two hemispheres not a single domesticated animal or

cultivated food plant in common? If the continent of Mu ever existed in the Pacific basin, as others assume in explaining these same early American cultures, why did not then the characteristic food plants of Asia reach America with the Asiatic civilizing strain, quite as in more modern times the Aryan peoples took their food and ornamental plants with them when they colonized Malaysia, and where their Sanskritic names for these plants still persist in the Malaysian languages, and quite as the Polynesians took Malaysian plants with them in colonizing Polynesia?

There is another school of anthropologists who support the idea that man reached America from Eurasia as a primitive nomad and that the development of the early American civilizations was purely autochthonous, not in the slightest influenced by the developments in Europe and Asia. The botanical and agricultural evidence is wholly in support of this theory.

Let it be noted that there was one domesticated animal common to both hemispheres previous to the period of European exploration, the common dog. It seems to be a safe assumption that man reached America from Eurasia as a primitive nomad, either bringing the dog with him, or receiving him later over a northern route. He may or may not have left Asia previous to the development of agriculture, although it seems probable that the time of his departure was early enough to antedate any generally established agriculture in Asia. In any case, in the long period involved in his migration over a northern route, in a region inimical to agriculture, not covering months or years, but rather generations, he would have lost all knowledge of agriculture in his life as nomadic hunter and fisher, and later contacts through the north could not possibly have brought him any agricultural knowledge from Asia. As he journeyed further to the south, reaching regions with favorable climatic conditions, and came in contact with wild plants yielding edible fruits or seeds or tubers, his development apparently paralleled that of man in Eurasia: first the gathering of the wild seeds for food, then the primitive cultivation of those plants best adapted to his needs, and finally the evolution of a really high-grade agriculture, the breeding of varieties adaptable to local conditions, the construction of elaborate irrigation systems in our own southwest and in Mexico, and of great terraces in South America. Step by step this paralleled the development of agriculture in the Old World, differing only in the species cultivated.

As agriculture developed it is logical to assume that the higher arts of civilization progressed, quite as in the Old World, including architecture, sculpture, hieroglyphic writing, and political, social, and ecclesiastical organizations. Whatever resemblances there may be between the early high American civilizations in Mexico, Yucatan, Central America and Peru and

those of Europe and Asia they are apparently fortuitous. Having no training as an ethnologist or as an anthropologist and hence having no preconceived ideas on the subject of common origins of arts and crafts, assuming that the early American civilizations were based on agriculture—and an agriculture, as has been shown, based absolutely and wholly on native American plants and animals—I can see no reason why man in America should not have been able, under favorable environmental conditions, to develop an independent civilization, quite as he developed an independent high type of agriculture. If he had borrowed his plants and animals from the Old World, then there would be every reason to believe that he also borrowed his civilization from Eurasia. In the field of biology, including botany and agriculture, the evidence is wholly in support of the theory that man reached America as a primitive nomad and that he here developed his own agriculture and his own civilizations, independent of any Old World contacts. There may have been accidental contacts across the Atlantic; there were relatively late contacts across the Pacific, for the Polynesians unquestionably reached the west coast of America in pre-Columbian times. But such accidental contacts as there were previous to 1492 had no important influences in modifying or shaping the early American civilizations. As in Europe and in Asia, so in America, the early civilizations were essentially from the soil.

Here is a fertile field that has received scant attention from the botanists or the anthropologists. The average systematic botanist looks on cultivated plants as organisms to be ignored, because they are not "native," and the average botanist in the field never collects a cultivated plant. The average anthropologist has too little interest in, or knowledge of the intricacies of systematic botany to cultivate this field successfully without the cooperation of systematic botanists. Let no one imagine that this is a simple field requiring only observations on which to draw conclusions. I know of no subject more complex, or one where there are more pitfalls to be avoided, among the numerous ones bordering on systematic botany, than this seemingly simple field of ethno-botany. It is an intriguing subject, and one that invites the closer cooperation of the botanist and the anthropologist.

NEW YORK BOTANICAL GARDEN

The Sachs text-book and its influence on the development of botany in America[1]

DOUGLAS HOUGHTON CAMPBELL

The middle half of the 19th Century witnessed the rise and development of modern botany, and it was in Germany that the greatest advances were made. From the early studies of Von Mohl and Schleiden, in the 40's to those of Sachs in the 60's, there is a long list of brilliant investigators in morphology and physiology. Sachs' great text-book was first published in 1868, and was an epitome of the results of the researches of such outstanding investigators as Hofmeister, Pringsheim, DeBary, and many others. The text-book was no mere compendium of what had been accomplished up to the time of its publication, but was a store-house of new and important facts based upon the original investigations of the author.

While Sachs is usually regarded as primarily a physiologist, the text-book covers the whole range of botany, and includes many new contributions to morphology and taxonomy which were of great importance, and strongly influenced the work of subsequent students in these fields. He was also greatly interested in the phenomena of sexual reproduction and hybridization and the chapters dealing with these questions, especially the bearing of hybridization on the origin of species, are notable—although of course he could hardly have anticipated the extraordinary discoveries of the geneticists of the present century.

In the preface, the author states that except where it was impossible to obtain material, the book represents the results of his own investigations—a witness to the enormous labor devoted to the writing of the book. The numerous figures are also for the most part original, and have never been surpassed for beauty and accuracy—indeed many of them have served for illustrations in innumerable text-books up to the present time.

This great text-book marks an epoch in the history of botany. The translation into English was undoubtedly the most important factor in the changed attitude toward botanical teaching in both England and America. The first English edition was published in 1875, and was made from the second German edition, published a year earlier. The book was thus made available to botanical students in England and the United States, who for the most part were quite ignorant of the important con-

[1] Invitation address. Memorial Program, Centenary of Julius von Sachs (1832–1897). Joint session of Section G, A.A.A.S., Botanical Society of America, American Society of Plant Physiologists, Mycological Society of America and American Phytopathological Society, December 28, 1932, Atlantic City.

tributions of the German botanists to morphology—physiology. A second enlarged edition, edited by Professor S. H. Vines of Oxford, was published in 1882.

While the most brilliant investigators in Germany were devoting themselves to morphology and physiology—in short to the biological aspects of botany—in England and the United States, the botanists were, with few exceptions, taxonomists, and their interests were almost exclusively with the vascular plants. The influence of such men as Hooker in England, and Gray in America, dominated the teaching of botany in the schools and colleges, and only in exceptional cases were teachers interested in plants as living organisms.

One of these exceptional teachers is worth mentioning, the late Professor W. J. Beal, of the Michigan Agricultural College. Among others of Sachs' students who attained distinction as botanists, was C. E. Bessey, whose *Botany for High Schools and Colleges*, published in 1880, and based to a considerable degree upon the Sachs text, attained a well deserved success, and had a great influence on the trend of both investigation and teaching. This book thus served to introduce the new botany to a host of eager students.

The decade 1870–80 was a notable one in the history of education in the United States. With the establishment of the Johns Hopkins University, for practically the first time the biological aspects of zoology and botany were generally reorganized, and this influence was soon apparent in the courses offered by many of the colleges. Of course there had been exceptional cases earlier where, as in the case of Professor Beal, teachers had an appreciation of plants as living organisms, and not primarily as "specimens," to be named and kept in the herbarium.

Up to this time very few American botanists had studied in Germany. In the early 70's, Dr. W. G. Farlow went to Europe, working under DeBary in Germany and Bornet in France. He was interested especially in the morphology and taxonomy of the algae and fungi, and on his return to America, established at Harvard courses on these which soon attracted many students, especially those interested in the fungi causing plant diseases. In 1878 a professorship of cryptogamic botany was established, to which Dr. Farlow was appointed. There were, at this time, very few special chairs of botany. Even Asa Gray was "Fisher Professor of Natural History." In 1872, Dr. G. L. Goodale was appointed Lecturer in Physiology, and later Professor of Botany.

When I entered the University of Michigan in 1878 I found a well organized introductory course in botany, which might very well have been based on the Sachs text-book. I believe the inauguration of this course was

due to Dr. Mark Harrington who had studied in Germany, and although not primarily a botanist, had been an instructor in this subject.

When I came to college, the work was in charge of the late Professor V. M. Spalding, who, however, at that time ranked only as instructor. Under his direction I was able to carry out a very satisfactory four years' course in botany, and I owe to him my introduction to the work of the great German botanists who at that time were the leaders in botanical investigation. The two names I shall always place first, so far as they directly affected my future work, were Hofmeister and Strasburger. I became greatly interested in Hofmeister's classic studies on the archegoniate plants, which, published eight years before the appearance of Darwin's "Origin of species," clearly demonstrated the genetic connection between Bryophytes and Pteridophytes, shown by a comparative study of their reproduction and embryology. The importance of these investigations was recognized in England, and in 1862 they were translated, and issued under the title, *Hofmeister on the higher Cryptogamia*. It was this book, brought to my attention when I was a student at the University of Michigan, that determined the direction in which my work was to proceed for many years.

As I continued my investigations it was evident that the very crude methods in vogue in our laboratories, were quite inadequate for satisfactory results in the embryological investigations in which I was interested. Little had, as yet, been done in our American botanical laboratories in the study of cytological technique, and it seemed necessary to go abroad for training in modern methods of fixing and staining cytological material. Strasburger was at this time recognized as the great authority, and in 1886 I went to Bonn to work in his laboratory. I may say that the semester spent under his supervision was quite the most important event in my training as a botanist.

As one realizes what men like Hofmeister and Sachs accomplished with the primitive means at their disposal, one may, perhaps, question whether the extraordinary advances in technique at the present day have yielded results of corresponding significance. One feels sometimes as if the perfection of the machine were often considered to be of greater importance than the results for which it was constructed.

LELAND STANFORD UNIVERSITY

Julius von Sachs, the man and the teacher[1]

RODNEY H. TRUE

I suppose there is hardly a botanist of middle age here who has not taken long draughts from Sachs' "Textbook of Botany" or from his lectures in Plant Physiology. If there be those of the younger generation who have not had this experience, let me here express the hope that they may not fail to drink of these springs of botanical knowledge and wisdom. I suppose, further, that of those who have handled these well-known volumes, many, like myself, have wished to know something of the powerful personality that gave those books a quality seen in no other author with whom I am acquainted.

Other speakers have the task of appraising the part Sachs will play in the history of plant science; it is my duty to outline here the results of my effort to glimpse that powerful personality that is partially revealed in the writings of Julius von Sachs.

Sachs was born in the capital city of Silesia, Breslau, on October 2, 1832. His birth added the third name to the list of great botanists coming into the world in that city in the same decade. Nathaniel Pringsheim was already nine years old and Ferdinand Cohn was a four-year-old boy when Sachs was born. Curiously enough, it would seem that although the accident of birth might have made a basis of intimacy or at least of acquaintance among them, it is doubtful that the boys were known to each other, and the elder ones certainly exercised little influence on the youngest member of the trio.

Sachs was born into the humble home of an engraver, a home in which financial hardship was the rule and where at times poverty may have entered. But this home did not lack an appreciation of the higher things of life. The father had a keen sense for the beautiful and to his occupation brought the instinct of the artist. Although the family were residents of the city for a greater part of the time, intervals of country living gave to the child an opportunity to see and to love the beauties of nature. He, too, at heart was an artist and out of these early days he brought a quality which blended with his later more confined scientific studies.

In the city he was sent to the Seminarial school in which the training seems to have consisted chiefly in committing lessons to memory in quite uninspiring surroundings. He rebelled against these drab conditions and

[1] Invitation address. Memorial Program, Centenary of Julius von Sachs (1832–1897). Joint session of Section G, A.A.A.S., Botanical Society of America, American Society of Plant Physiologists, Mycological Society of America and American Phytopathological Society, December 28, 1932, Atlantic City.

found less profit in his school work than in the training in drawing given by his father. From the 13th to the 16th years of his life, he drew and painted flowers, fungi and other natural objects.

Although the other young botanists-to-be seem not to have come into his life, he was fortunate in making the early acquaintance of two sons of Purkinje, the physiologist, then a member of the faculty in Breslau University. From these boys he learned to collect and press plants, and learning that herbaria were made for their preservation and study, he began to make an herbarium for himself. In this work he had the support again of his father who knew the common names of many of the plants of the region.

Arising with the dawn, he made excursions into the country about the city, and made himself an herbarium of plants that at the age of fourteen he determined for himself from a local flora. Somebody stole his herbarium and inflicted on the boy his first great sorrow. He told his loss to everyone and could not understand the indifference of others to this great disappointment. Goebel, probably relying on an autobiographical account shown to him by Miss Sachs, states that Sachs did not collect plants again until as Professor he assembled a collection for purposes of instruction. This attitude did not arise from any indifference to this phase of his science, since much later he writes in a letter: "To me the so-called *physiologists* to whom the commonest plants of the meadows and gardens are unknown are very unpleasant (unangenehm); these very people are apt to possess very little knowledge of physical things also." He retained throughout his life an interest in the general problems of Systematic Botany.

The seminarists having proved so sterile for the boy, his mother suggested that he should be favored, as none of his brothers before him had been favored because of family poverty, and he enrolled in the Gymnasium. Here he was happy and for five years (1845–'50) was first in his class. He came into friendly terms with one of his teachers, Dr. Rumpelt, and encouraged by him looked forward enthusiastically to scientific pursuits. In spite of the warning of Körber, his botany teacher, that he would never get a groschen for all of his science, he made a collection of skulls and went on his way.

In the year 1848, when he was sixteen years old, dire calamity visited Julius. His father's death was closely followed by that of his mother, and the orphan went to live with an older brother, who out of his own scanty resources provided the boy with an unheated room under the roof. This was gladly accepted and in his attic chamber our young scientist pursued his studies, among his other tasks mastering the contents of Bertholinus' Anatomy written in Latin. Soon, however, affairs became so bad that with

regret he gave up his course in the Gymnasium and planned to become a sailor.

At this critical juncture, when science might have lost one of its future leaders, the acquaintance with the Purkinje family brought to bear a decisive influence that changed his plans. Professor Purkinje had accepted a call to the Czechish University of Prague somewhat before this time, and from his new place of residence offered Julius employment as his private assistant. The lad, now nineteen years of age, went to Purkinje and to Prague. Here he became a student, it is true, but only in so far as his time and effort were not demanded by his employer. It seems that Purkinje paid him poorly and demanded much. He was obliged, as best he could, to eke out his little pay by doing such outside work as he could obtain in order to get a bare living. For six years he was Purkinje's "laboratory slave," six years "rich in self-denial," as one of his biographers says. During these years of overstrain, in order to keep himself nerved up to meet the demands of his master and to accomplish somewhat as a student, the youth, hardly more than a boy, resorted to the overuse of stimulants and formed habits that unfortunately remained with him through life and at times greatly colored his relations with others. It should be said, however, on Purkinje's side that his influence probably did much to turn Sachs' attention toward physiology and gave him command of the methods of the animal physiologist, some of which were later used by him in his work on the physiology of plants. Although there seems to have been little to show for botany in the University of Prague at that time, Sachs left some records of work done during this period. He learned the Czech language, that of Purkinje and of his University, and published his earliest botanical contributions in Purkinje's Czechish periodical—*Ziva*. His first paper on "Growth" appeared in 1853, when Sachs was twenty-one years old and, curiously, was presented in the form of a dialogue. Whether Sachs took this form of composition from philosophical writings that he was then studying with great interest, or whether the teaching instinct so strongly developed in him later led him to choose this type of discourse, is hardly to be decided. At all events, this seems to have been the only instance in which he used this form of presentation.

Some reflection of the philosophical tendency of the times is seen in his next contribution on "Metamorphosis" published a year later. Before the years of his apprenticeship in Purkinje's service expired Sachs had put out two more papers in *Ziva*—one on Starch and another on Transpiration, in 1856. In that year, when twenty-four years old, Sachs took his doctor's degree at Prague.

In view of the weakness of botany in that University at that time, it

seems pretty clear that Sachs proceeded to his goal quite independently of outside stimulus and became a botanist by virtue of his own strong inclination and determination. His Habilitationschrift as Privatdocent in the same University followed in 1857, the year in which he left the service of Purkinje. In that year he brought out his paper on the position of lateral roots, using in his study plants grown in water. This circumstance seems to have attracted the attention of the agricultural scientists, although the use of river water as a culture medium for growing plants had been used long before Sachs' time. At all events, in 1859, Sachs was called to his first paying position, that of physiological assistant in the Agricultural Academy of Tharandt, with the special problem set before him of developing a method of growing plants in nutrient solutions. He tarried here for two years, moving in 1861 to the old Poppelsdorf Castle in Bonn, where the Agricultural Institute was then quartered. Here he seems to have made really helpful botanical contacts with Hanstein and with Greyor Kraus. His *Handbuch der Experimental Physiologie*, a pioneer work in which much of his own investigations found place, belongs to this rather brief stay.

Heretofore his work had been that of the laboratory, and the other side of Sachs, the teacher, had found little opportunity for development. His next move, in 1868, to the chair of Botany in the University of Freiburg in Breisgau, as the successor of DeBary, gave him this opportunity. After a year in Freiburg he ended his academic travels by succeeding Nägeli at Würzburg in Bavaria. Here he remained in spite of calls to Heidelberg, Vienna, Berlin, Jena and Munich, and to Würzburg came men from many parts of the world. Two causes seem to have contributed to this concentration in Sachs' laboratories. He had given form and distinction to a new aspect of plant study—Plant Physiology—which can hardly be said to have existed as a defined science before his day. He presented his novelty with a rare charm and power of attraction.

This leads us to an inquiry into those characteristics that made Sachs a distinguished man and one of the most influential teachers known to the history of Botany.

We have already heard somewhat of the hardships that marked his early life, how poverty and ceaseless work had surrounded and wellnigh submerged him. We have heard also how, in spite of them, he had kept his course and achieved as few have achieved. We know that strength gained is measured by obstacles overcome, but sometimes the indomitable will may drive the machine that serves it beyond the limits of safety and finally wear it out. This seems to have happened to Sachs. Taxed beyond the safety limit while yet young, he prematurely found himself handicapped

by severe digestive ills that did much in later years to reduce his activity and to burden his life. Moreover, this tended to influence his attitude toward his fellowmen by making him impatient of their failings, and harsh and at times unjust in his judgment. Gifted himself with a keen and instantaneous insight, he became a severe censor. He was specially impatient of what seemed to him superficial and ill-conceived. He found little to appreciate in the prevailing Platonic ideas of morphology, and although a profound vitalist in his fundamental philosophy, he strove not only to bring plant physiological problems into the region of causality, but sought to bring morphology into that region also. This occasioned sharp collisions with certain of his colleagues. His attack was severe and direct when he caught sight of what he believed to be slipshod. When he met a direct and courageous opponent, his scorn turned to respect, and one who could successfully and boldly overcome his attack not rarely became his firm friend. His scorn was heaped high on one who used as common property, without acknowledging the source, results gained by him. One aspect of this scientific communism that often irritated him was the use of his remarkably accurate and artistically executed drawings that helped to make his "Textbook" and "Physiology" famous, without giving him due credit, and when credit was given he complained that the reader of the work using the illustrations would think that Sachs was a hired artist working for the author. However, one can but ask what botanical writers and students of plants would have lost had they not been able to refer to his well-known figures. It seems probable that this sensitiveness arose out of some kind of complex originating in the early, hard days of his life that put him unduly on the defensive in his later years of pre-eminence. His humble birth was made the basis of stinging remarks during his days with Purkinje, "Bauer" he may have been called, but he failed to draw the sting from the slur, as many would fail now, by adopting a broad, sympathetic view of humankind. Still, one is glad to know that this caste-bound mind must have prized the desired appreciation when, in his later life, he recieved the coveted title of "Geheimrath" and was ennobled by the King of Bavaria.

In view of the background that I have tried to suggest, it is not difficult to see how he became the great teacher,—probably one of the greatest that Botany has known. Given a keenly sensitive organization, artistic in its fundamental characteristics; given wide reading in philosophy and other fields, and a tendency to seek the general principle, it is clear to see how in his *Lehrkanzel* where he was perfectly free to pour out his wealth of knowledge and enthusiasm to those who eagerly listened, he would feel and transfer the thrill that would make him irresistible. It seems to me

likely that Sachs found a very keen, and in time, longed-for type of satisfaction in this form of self-expression.

For the few who in the beginning perhaps successfully defied and later loved him, he showed another side of his complex and somewhat veiled nature. His assistants felt the cordial warmth, the solicitude for them in the details of the day, and the outflow of confidence, that remained to them a precious possession. The irritable, easily scornful and bitter man seen by so many was the overworked, overstimulated, half-invalid Sachs, driven by the failure of lesser men to appreciate and acknowledge what he had done or to see what to him was so plain. The brilliant teacher, the gentle, considerate friend and companion, the artist-turned-botanist, was the man whom we know best.

I cannot close without a few words regarding Sachs in his literary capacity. It is almost a habit to think of the German scientist as the writer of turbid, involved and difficult sentences, and all of this justly applies to many. None of these characterizes the writing of Sachs. For clarity, coherence and charm, I wish to commend his *Vorlesungen der Pflangenphysiologie*. The same applies to many of his *Abhandlungen*. When the writer was a student with one of Sachs' most famous botanical children, Pfeffer, he often regretted that the master had not passed on to him that straightforward, lucid style of speaking and writing. However, Pfeffer was worthy of his master.

In view of the tremendous growth that we are now seeing in the old sciences of Physics and Astronomy, it would be ill-advised to say that the advance of human understanding may not later cause another epochal chapter to be written into the history of Botany. Perhaps with the application of the new methods now being developed in Physics and Chemistry, someone may add another great area to botanical knowledge. Perhaps another Sachs may appear.

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Sachs, the last of botanical epitomists[1]

CHARLES E. ALLEN

An introductory reference may be pardoned to a topic already discussed today by one who speaks with authority. The development of botanical knowledge during the nineteenth century is recorded in successive editions of three great German textbooks. Schleiden's text, which began to appear in 1842, apart from its important polemic aspect, aimed to present a comprehensive exposition of the science. The precedent thus established was to be scrupulously observed by Schleiden's German successors. Twenty-six years later came the first edition of Sachs' *Lehrbuch*. That its author approached more nearly the ideal, that in organization, in proportion of emphasis, in tolerant yet critical comprehension of others' contributions his text far excelled—these facts but emphasize the significance of his own comment, that the difference between Schleiden's "and all previous textbooks is the difference between day and night." Thanks to Schleiden, argument, exhortation, and denunciation were no longer required to establish botany on the basis of an inductive science. It remained, however, for Sachs to present a summary, satisfying, in its completeness and symmetry, his own critical artistic sense, a summary which, allowing for the contemporary state of knowledge, has never been excelled.

When, after another twenty-six years, a third—the *Bonner Lehrbuch*—appeared, it is noteworthy that its production involved the collaboration of four specialists. That such collaboration was needed is an added indication of Sachs' position in the history of botany. Not only had he, while engaged in providing formative stuffs for the still wholly meristematic shoot of plant physiology, organized and epitomized the botanical knowledge of his day; he represented the climax and marked the close of a period in which such mastery by a single mind was possible. Previous to the transitional stage personified, as it were, by him, there were masters of botany. Since, there have been masters of special botanical fields. "General botany," thought of as a term describing the activities of an individual, was thereafter to be, like "general biology" or the later-invented "general physiology," meaningless save as an expression of pious aspiration, or as a claim of transcendent importance for the user's particular line of interest.

When, after successive revisions of the *Lehrbuch*, Sachs could not, despite his fondness for arduous labor, drive himself to the preparation of

[1] Invitation address. Memorial Program, Centenary of Julius von Sachs (1832–1897). Joint session of Section G, A.A.A.S., Botanical Society of America, American Society of Plant Physiologists, Mycological Society of America and American Phytopathological Society, December 28, 1932, Atlantic City.

a new edition, he turned to the writing on a freer plan of his *Vorlesungen über Pflanzenphysiologie*. His work as a physiologist, also, has been covered today by one who knows his pH, and is not to be detailed here. But it will be permissible to note that the *Vorlesungen* represents a natural development of the *Lehrbuch*, covering a large proportion of the same subject matter, and illustrating Sachs' views as to the proper content of plant physiology. Nearly a fourth of the first edition of the *Vorlesungen* (1882) is devoted to organography, including the morphology and anatomy of vegetative parts, and cell structure. Somewhat more than one tenth is given to reproduction with extended descriptions of gametogenesis and syngamy, and discussions of devices insuring self- or cross-pollination, of apogamy, and of the effects of hybridization. It may, to be sure, be suggested that the so-inclusive treatment of his subject was the expression of a view persisting from the days before his own contributions had increased and organized physiological knowledge. When, as a young *Privatdozent*, Sachs first announced a course of lectures on plant physiology, a chemical friend inquired (of course in courteous Teutonic phraseology): "How do you get that way? You can cover the subject in two hours." And Goebel, relating the incident, adds that, considering the period, the chemical friend was not so far astray. Whatever the explanation may be, Sachs' lectures on plant physiology evidence, like his textbook, his power of organization and summary within an extremely broad field.

With Sachs' *Vorlesungen* may be compared the first edition of Pfeffer's *Pflanzenphysiologie*, which, although representing a younger viewpoint, appeared a year earlier. Pfeffer has nothing to say of organography, unless a brief description of protoplasmic structure be therein included, and nothing of reproduction save a paragraph discussing the movements of archegoniate antherozoids. The difference in inclusiveness and the shift of emphasis as between master and student are significant. Sachs, throughout his active life, stressed the unity of structure and function as varied aspects of a single problem. To Pfeffer, physiology was *Stoffwechsel und Kraftwechsel*. Even this definition might have covered the complex of phenomena included under, or related to, reproduction; but Pfeffer did not so interpret it. The latter's predominance in the physiological field after Sachs had passed from the scene determined a limitation of the activities of those calling themselves plant physiologists much narrower than any possible to the mind of Sachs. The effect of this limitation is illustrated by a sentence in a much later textbook of plant physiology prepared by one of Pfeffer's American students: "That topic [reproduction] is relegated to morphology, since the purely physiological processes are relatively simple, so far as known, and very much alike."

Doubtless, one reason for Pfeffer's willingness thus to limit the subject matter of physiology lay in the appearance of the new school of cytologists who were rapidly advancing the knowledge of reproductive processes, and who, as it happened, were predominantly men of morphological and anatomical training. Had Sachs' comprehensive, rather than Pfeffer's more limited, view as to the proper scope of plant physiology prevailed, meetings of physiologists might now be listening to accounts of chromonemata, genic localization, and segmental interchange. It is eminently fitting that present-day plant physiologists revere the memory of Pfeffer.

The breadth of Sachs' interest in, and his inclusive mastery of, botanical subject matter are likewise evidenced by the variety of problems outside the range of plant physiology, broadly or narrowly interpreted, to which his own researches and those of his students contributed. His interest in strict morphology, early illustrated by the papers on *Crucibulum* and *Collema*, appears in his later discussions of "architypes," and in his extensive investigation, recorded in the *Lehrbuch*, of the structures of archegoniates. Inherent throughout his writings, and repeatedly expressly stated, was the conviction already referred to, that structure and function must be considered together. Down to the time of writing the very latest of his published papers he was attempting to disentangle and elucidate the factors causal to the development of form; discriminating more and more sharply between environmental stimuli and internal factors, the latter identified by such terms as *Gestaltungstrieb*, nowadays more orthodoxly, if not more illuminatingly, embodied in the concept of the genotype. One contribution to this problem of the causation of development was the doctrine of formative stuffs; another, the discussion of the bearing of growth tendencies upon the appearance respectively of radial or of bilateral symmetry. In the field of causal morphology his tradition was continued by his student Goebel, as another student, Pfeffer, represented a continuation of Sachs' interest in *Stoff- und Kraftwechsel*.

His morphological studies bore close relation to, perhaps were in part an outgrowth of, his concern with problems of relationship, the fascination of which he admitted having felt from youth. Goebel quotes him as saying that he had followed physiology because it seemed to him that "the final problems of systematics are to be solved only by physiological methods." These questions of relationship—"the final problems of systematics"—inevitably led him, as a contemporary of Darwin, into discussions of organic evolution, just as the problems of causal morphology drew him to the consideration of the bases of inheritance and variation. His change in attitude toward Darwin between the time of the appearance of the German, and that of the publication of the English, edition of his history is well

known. While accepting the doctrine of descent, Sachs abandoned faith in all attempts, including especially the theory of natural selection, to explain the evolutionary process. "The natural system," he said, "is explicable only by descent; how descent is to be explained, nobody knows."

In the field of inheritance, the doctrine of the continuity of the embryonic substance in plants antedated, as has often been pointed out, Weismann's adoption of the distinct, but related, hypothesis of the continuity of the germplasm. This embryonic substance of meristematic cells, Sachs said, "has remained continuously alive since the beginning of organic life upon the earth, constantly renewing itself, persisting through the changes to which all organisms are subject, as well as through the endless alternation of life and death." After the establishment of the chromosome theory by Hertwig and Strasburger, Sachs, like Weismann, accepted and included in his conception the preponderant influence of the nuclear substances; although he stated, more clearly than some of his contemporaries, the significance of the cytoplasm and of its interaction with the karyoplasm in developmental processes.

An early statement of the energid concept contains an anticipation of Richard Hertwig's theory of nucleo-cytoplasmic relations. It may not be too fanciful to suggest that in the formulation of this concept, not fully confirmed by later studies of the organization of multinucleate cells, Sachs was a victim of the intellectual limitation which inhibits our analysis of phenomena of almost any type save in terms of small and ever smaller units. A logical development of the fruitful ideas basic to the energid hypothesis was the study by Amelung, at Sachs' instigation, of average cell sizes and of the relation of cell size to organ and body size. A sentence from one of his letters to Noll is suggestive in this connection: "The time will come, as I have often said, when the deepest secrets of nature will be sought, not by means of metallic contrivances, but in the energids themselves."

Another problem to which Sachs repeatedly turned was that of the laws which govern the sequence of cell divisions and the resultant intersections of partition walls. Although the question had already engaged the attention of Hofmeister, the conceptions developed by Sachs supplied the real starting-point for later work. This study in turn led to a consideration of the relation between growth and cell division. His insistence upon the unity of the multicellular organism as a regulatory factor in the determination of directions of growth and planes of division led to the enunciation of what has been considered one of the many forms of the "organismal" theory. However, it is not without significance that maturer consideration led him far enough away from his former somewhat mystical attitude to

enable him to point out that "the total form of the plant and the succession of its organs are determined by the energids alone."

But it is as a historian of botany that Sachs' characteristic power of summary and epitome is most evident. His History of Botany from 1530 to 1860 is still, and promises for many years to remain, the only work in its class. Although nominally limited to the dates mentioned, there are expositions, brief but enlightening, of progress from ancient times to the beginning of modern botany. So general has been the recognition of his erudition, thoroughness, skill, and judgment in this presentation of the growth of botanical knowledge through the centuries, that an attempt at further comment would be superfluous. That errors of fact and of judgment should have been discovered is not surprising; it is surprising that errors were so few.

Sachs' purpose cannot be too clearly recognized in any critical evaluation of his History. He deliberately refrained from cataloguing discoveries of facts save "when they could be shown to have promoted the development of the science." This recalls an earlier expression of his attitude in the preparation of his *Lehrbuch* which, he said, was intended to familiarize the beginner "not only with the most important facts at present established concerning the life of plants, but also with the theories and problems with which botanical investigation is at present chiefly concerned." In like vein was his insistence that "scientific merit belongs only to the man who clearly recognizes the theoretical importance of an idea, and endeavors to make use of it for the promotion of his science."

There is, of course, another real aspect of the history of a science. In this aspect the historian seeks to trace the accumulation of the knowledge of facts, as well as the process of elimination of those accumulated "facts" which are not facts. This type of study of the development of a branch of knowledge has its own particular value; but it was not the type of study that appealed to Sachs. To him, the true aim of the history of a science was "to discover the first dawning of scientific ideas and to follow them as they developed into comprehensive theories." Considered from this standpoint, his History speaks as nearly the last word as any historical work possibly can.

The point at which Sachs closed his chronicle marks approximately the end of the period within which one writer could successfully summarize botanical accomplishments with an important part of which he was contemporary. In the writing of history also, then, Sachs was the last of botanical epitomists. In a remote future, after many workers have reviewed the history of developments in their special lines, and when time has obscured much of passing interest that bulks so large while it is passing, some

writer, assimilating the results of these studies of phases of the science of which he knows personally relatively little, may record the development of botany as a whole from 1860 to 1960. But such a one will not be doing the work that was done by Sachs.

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A carpological enigma

H. H. Rusby

(with plate 20)

In the summer of 1921, while on the Mulford Expedition, Dr. O. E. White collected, in the vicinity of Rurrenabaque, Bolivia, a leafy and a fruiting twig, the edible fruit of which possesses a structural peculiarity not heretofore described, so far as I can ascertain, and the morphology of which I am unable to explain.

The plant is quite clearly a member of the Myristicaceae, but does not fit into any described genus. The only information accompanying the specimen is Dr. White's notation. "*Durasno del monte. Mui rico*," which I interpret as "Mountain or Wild Peach. Very rich." Whether it is the pericarp or the seed that is eaten and is "very rich," is not stated. The fruits are apparently immature, and not fully grown. They are paniculate and pendulous on stout and tough branchlets and pedicels, and the base is slightly umbilicate at the stout attachment. The fruit is about as large as a good sized peach, which it closely resembles, the surface being downy as in the peach. It also closely resembles the fruit of the nutmeg. There is no sign of a suture, and in its present immature state, no indication of dehiscence. The sarcocarp is about 6 mm. thick and is not very tender or fleshy. I assume that it has become contracted and hardened by its long immersion in formaldehyde, and that in a mature and fresh condition, it might be much more attractive for eating. The putamen is 1.5 mm. thick and is at present adherent to the sarcocarp. It is crustaceous in texture and of a white color throughout, and its inner surface is smooth and shining. The solitary seed is erect and atropous and is irregularly globose. It entirely fills the cavity, being about 4 cm. long and broad. It is white in color and has a broad, brown, flat or slightly impressed hilum. Running from the hilum are a number of shallow and irregular grooves and ridges. There is no aril, but its strange and inexplicable feature is the partial envelopment of the seed in a leaf-like organ that originates from the tip of the pericarp. From the material at hand, I am unable to determine from which layer of the pericarp it originates. It has a short and rather stout dark-colored petiole, which is continued into a stout midrib that curves along the surface to the hilum and sends a number of weak branches out into the thin and hyaline lamina that partially surrounds the seed. The surfaces of the leaf are entirely free from both the seed and the endocarp. The seed consists mostly of fleshy endosperm, with no separable testa or tegumen. This white endosperm is irregularly crumpled but is firm and compact, and appears as though it might well be edible, like a nut. The

large centric embryo is broad, thin but tough, and strongly and irregularly crumpled. It has a well-formed short, stout, dark-colored and shining caulicle. A twig bearing two leaves is present. These are alternate and without indication of stipules. The petioles are short, stout and slightly twisted as though they might have served for support, though this is conjectural. They are broadly ovate, obtuse, entire, thin but tough, pale-green and glabrous, the venation rather sparse but strong and prominent, giving the leaf a rugose appearance.

Both fruit and seed manifest affinity with the Myristicaceae, but differ in the absence of an aril, and in the presence of the intra-carpellary leaf-structure here described. I have been unable to find any other family to which it could have been so well referred.

If one could imagine that the leaf-like appendage to a stigma, such as we see in *Stigmaphyllon*, had become reflexed and involved as a lining to the ovary, we should have an exact picture of the position of this unique intra-carpellary appendage.

Although apparently no such genus has been described, it seems undesirable to propose a name for this plant until we have more complete information concerning it.

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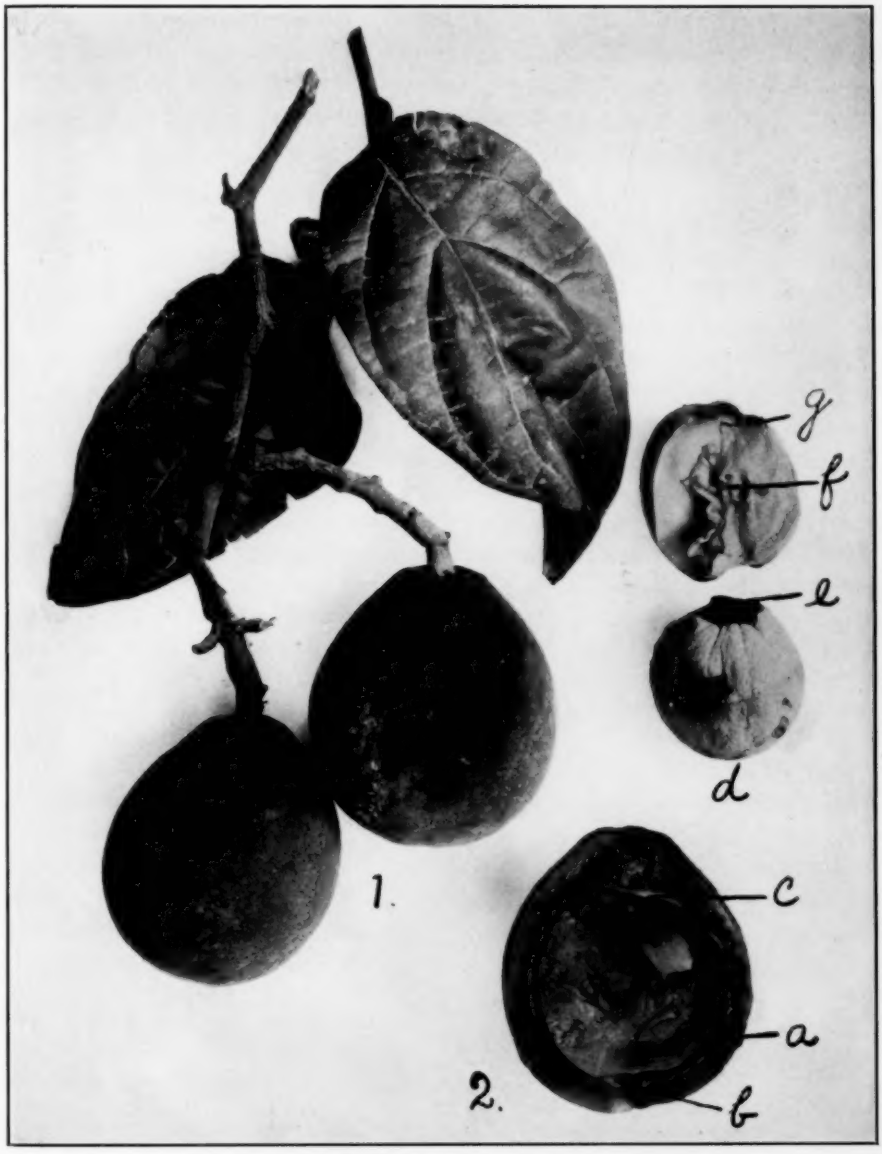
Explanation of plate 20

Durasno del Monte (Myristicaceae) Fig. 1, leafy and fruiting twigs; Fig. 2, longitudinal section of fruit; a, petiole of intracarpellary leaf; b, point of origin at tip of pericarp; c, portion of lamina; d, exterior of seed; e, hilum; f, crumpled cotyledons of embryo; g, tip of caulicle near micropyle, (slightly reduced).



RUSBY: CARPOLOGICAL ENIGMA

UNIV. OF MICH.

Plantae Krukovianae

H. A. Gleason and A. C. Smith
(with plates 21, 22)

During the last few months of 1931 Mr. B. A. Krukoff made collections, largely of forest trees, in Amazonian Brazil. The collections were chiefly from two regions: the plateau between the Xingu and Tapajos Rivers in the State of Pará, and the region of the Machado River (Madeira River system) in the State of Matto Grosso. The present paper is planned to describe the new species collected by him. All types are deposited in the herbarium of the New York Botanical Garden. The authors wish to thank the specialists E. P. Killip, E. C. Leonard, H. N. Moldenke, C. V. Morton, P. C. Standley, and R. E. Woodson, for their cooperation in determining and describing certain specimens.

Araceae

Philodendron Krukovii Gleason, sp. nov. Caules graciles epiphytici subteretes glabri ad laterem unum biangulati et leviter sulcati, internodiis ad 25 mm. longis; petioli recti 4–7 cm. longi, e basi expansa caulem amplectente contracti, superne 3–4 mm. lati, lateribus parallelis, supra plani vel leviter canaliculati subtus rotundati vel paullum angulati anguste alati; alae vaginales cartilagineae, infra basin laminae supra petiolum confluentes et in ligulam obtusam 1 mm. longam productae; pars petioli libera 2 mm. longa; laminae subcoriaceae opacae virides lanceolato-oblongae subfalcatae inequilaterae 14–24 cm. longae 35–65 mm. latae, latere dextro quam sinistro fere 1/2 latiore, infra medium ad basin rotundatam sensim angustatae, apice acuminatae; venae laterales I in quoque latere ad 9 a costa sub angulo 70° divergentes, ultra medium sursum curvatae et prope marginem tenuiores cum aliis conjunctae, supra planae obscurae subtus stramineae paullum elevatae; venae laterales II numerosae creberrime parallelae inter se circa 1 mm. distantes, prope marginem a venis I non distinguendae et cum eis conjunctae, supra virides obscurae subtus stramineae, utrinque paullulum elevatae, venulae numerosae; pedunculus solitarius terminalis crassus 1 cm. longus purpureo-brunneus; spatha lanceolata supra basin 35 mm. lata 9 cm. longa, ad apicem obtusa vel subrotundata et appendicula tereti 5 mm. longa ornata, spadicem aequans; spadix circa 8 mm. stipitatus subteres ad basin atropurpuream vix incrassatus, ad 7 mm. diametro, superne flavo-brunneus sensim angustatus.

Type, *Krukoff 1408*, collected Nov. 23, 1931, near Tabajara, upper Machado River region, State of Matto Grosso. A member of Sect. *Pteromischum* Schott, it finds its nearest relative in *P. guttiferum* Kunth, in which the leaves are proportionately twice as wide, of an ovate-lanceolate type, and the petiole much more broadly winged.

RAPATEACEAE

Saxo-Fridericia australis Gleason, sp. nov. Foliorum vaginae basales lineari-lanceolatae ultra 34 cm. longae et 3 cm. latae, superne in petiolum gradatim angustatae, in parte superiori marginis unae spinuloso-serratae, in margine altera integrae; petiolus inter laminam et vaginam haud evolutus 7 mm. diam. glaber, marginibus anguste alatis et spinuloso-denticulatis, spinulis subulatis rectis patentibus; lamina lineari-lanceolata ad 165 cm. longa, latere uno 4.5 cm. lato basi longe cuneato, altero 3.5 cm. lato et 1–9 cm. altius oriente, ad marginem in parte inferiori spinuloso-denticulata velut in petiolo, superiori minutissime adpresso-spinulosa, apice longissime acuminata, supra glabra, vena media canaliculata 5 mm. lata, subtus concolor, costa crassa semitereti, venis lateralibus in quoque latere 7 vel 12, lineis albidis transversalibus divisis et anastomosantibus creberrime notata; pedunculus ultra 40 cm. longus gracilis, in sicco angulatus, glaber, superne vix incrassatus vel ad 8 mm. latus; capitulum fructiferum globosum 3 cm. diam.; bracteae jam post maturitate in speciminibus plurimis delapsae, in una sola capitulum partim obtegentes; capitulum globosum multiflorum 3 cm. diam.; flores singuli cum bracteolis turbinati vel obconici 12 mm. longi; bracteolae circ. 30 lineari-clavatae acutae vel breviter acuminatae, exteriores 1-nerviae 7 mm. longae in parte superiori 0.8 mm. latae, interiores 3–5-nerviae and 10 mm. longae 1.8 mm. latae, omnes adpressae induratae; sepala lanceolato-oblonga 11 mm. longa 3.3 mm. lata 5-nervia basi scariosa apice indurata acuminata; capsula ellipsoidea 7 mm. longa in rostrum brevem abrupte angustata obscure 3-angulata loculicida 3-locularis; semen 1 reniforme paullum complanatum 5 mm. longum glabrum medio affixum; antherae post anthesin persistentes e calyce exsertae linearisubulatae 4.5 mm. longae, ad apicem in apiculam linearem 0.4 mm. longam subito angustatae, infra apicem poris 2 elongatis vel rimulis 2 brevibus 0.6 mm. longis dehiscentes.

Type, *Krukoff 1065*, collected Sept. 10, 1931, on "terra firma" on the plateau between the Xingu and Tapajos Rivers, State of Pará. The specimens are unfortunately past anthesis; in one the remains of the typical involucre persist and in a few withered anthers still persist on the fruiting heads. The habit of the large leaves, and the structure of the involucre and anthers leave no doubt of its generic affinity. The characters of the genus and its three species hitherto known were well summarized by Koernicke in 1872. *S. regalis*, of the Roraima region, has well imbricated bracteoles gradually increasing in length from the outer to the inner; the other two have bracteoles of nearly the same length and in that respect agree with ours. *S. subcordata* has leaves cordate at base, while *S. aculeata*, of French Guiana, further resembles ours in leaves narrowed to the base. The last species differs from ours in the margin of the petiole and leaves, which are spinulose-denticulate throughout their entire length with tri-

angular incurved teeth, and in its shorter peduncle strongly expanded beneath the head. The fruit of *S. aculeata* was unknown to Koernicke. Its ovary contains two ovules in each locule, in which it agrees with *S. australis*.

Few species of the family are known from south of the Amazon, and the present collection extends the range of the genus by about 500 miles.

Marantaceae

Ischnosiphon flagellatus Gleason, sp. nov. Caulis simplex erectus herbaceous 60 cm. altus, basi vaginis obtectus, vaginis lanceolatis adpressis pallide brunneis vel stramineis longitudinaliter venosis ab inferioribus 15 mm. longis ad superiores 10 cm. longas gradatim accrescentibus; vaginae foliorum ad 13 cm. longae internodia omnino tegentes, minute pubescentes praecipue ultra medium, ad apicem in linea pubescenti cartilaginea obliqua a basi petioli ad margines vaginae extensa et prope marginem setis 2 erectis ad 10 mm. longis ornata terminantes, ultra apicem ligulam intrapetiolarem 6–8 mm. longam ovato-oblongam integram glabram gerentes; petioli crassi complanati dense puberuli 2 mm. longi; laminae foliorum inferiorum ovatae 9 cm. longae 4 cm. latae basi rotundatae apice acutae, superiorum lanceolato-ellipticae ad 18 cm. longae 6 cm. latae acuminatae, basi subrotundatae vel late cuneatae, omnes ad venam mediam minutissime puberulae ceterum utrinque glabrae, apice rectae; spica ex axilla folii superioris solitaria sessilis jam a bractea singula straminea superne spiraliter torta omnino obtecta; flores nondum evoluti.

Type, *Krukoff 1307*, collected Nov. 7, 1931, on "terra firma" at Calama, Madeira River region, State of Amazonas. *I. flagellatus* is apparently related to *I. surinamensis* (Miq.) Koernicke, but differs from it and all other described species in the structure of the ligule.

Myristicaceae

Virola elliptica A. C. Smith, sp. nov. Arbor 20–25 m. altus, prope basin 0.6–0.8 m. diametro; ramulis rectis teretibus glabris, in sicco rugosis nigrescentibus; petiolis velut ramulis, 7–9 mm. longis, 1.5 mm. diametro, inferne teretibus superne canaliculatis; laminis coriaceis oblongis, 12–20 cm. longis, 3–5 cm. latis, basi cuneatis, apice breviter acuminatis vel acutis, margine integris et leviter recurvatis, utrinque glabris, supra nitidis saepe subnigrescentibus, subtus fuscescentibus, costa supra plana vel leviter impressa subtus prominente, nervis secundariis 18–22-jugis subrectis prope marginem arcuatis conjunctis, supra peracute impressis subtus elevatis, venulis immersis; inflorescentiis axillaribus in fructu ubique glabris quam foliis paullo brevioribus; fructibus breviter pedicellatis oblongo-ovoideis, maturitate 3 cm. longis et 1.6 cm. latis, longitudinaliter acute circumcarinatis; pericarpio sublignoso saepe rugoso, arillo fere ad basin laciniato, semine ovoideo, 20–30 mm. longo, 13–14 mm. lato.

Type, *Krukoff 1333*, collected Nov. 12, 1931, on "terra firma" near Tabajara, upper Machado River region, State of Matto Grosso. Like other Brazilian species of the genus, it is locally known as "Ucuuba." It is allied to *V. carinata* (Benth.) Warb., from which it differs by having the secondary veins acutely rather than bluntly impressed, and by having the fruit elliptic. The fruit of the present species is about twice as long as broad, while that of *V. carinata* is subglobose and smaller. *Krukoff 1496*, also from the vicinity of Tabajara, is identical with *1333* in foliage, but differs by having its fruits larger (often 5 cm.×2 cm. at maturity) and with the longitudinal ridge less prominent. In view of the similarity of these two specimens in all other features, I am inclined to consider them one species. However, future collection of the flowers may indicate that two species are represented.

Two species of *Iryanthera* of which the fruit has not previously been described were collected by Krukoff. The following notes may be added to descriptions of the species:

IRYANTHERA JURUENSIS Warb. Fruiting inflorescence 8–9 cm. long; fruit short-pedicelled (pedicel 5–10 mm. long), transversely elliptic, about 3.5 cm. thick and 5 cm. on the long axis, substipitate at base, rounded at apex; pericarp woody, very rugose, about 7 mm. thick, vertically dehiscent; aril entire; seed transversely elliptic, about 33 mm.×18 mm.

Matto Grosso: near Tabajara, upper Machado River region, *Krukoff 1391*. Our specimen is a tree about 30 meters high and 1 meter in diameter, breast high, with the local name of "Ucuuba vermelha." The collector notes that the inner bark gives a thick red exudation.

IRYANTHERA ULEI Warb. Fruiting inflorescences fasciculate, 5–7 cm. long; fruit pedicellate (pedicels 4–6 mm. long), transversely elliptic, about 14 mm. thick and 25 mm. on the long axis; pericarp rugose, about 1 mm. thick, vertically dehiscent; aril entire; seed transversely elliptic, about 23 mm.×12 mm.

Amazonas: near Calama, Madeira River region, *Krukoff 1298*. The collector notes that the specimen is a tree about 16 meters high and 0.3 meters in diameter, breast high; a local name is "Ucuuba rana," and the seeds are used for extraction of oil.

MONIMIACEAE

Siparuna Krukovii A. C. Smith, sp. nov. Frutex circiter 6 m. altus; ramulis subteretibus fuscis, parce stellulato-pilosis mox glabrescentibus; petiolis oppositis gracilibus subteretibus 5–7 mm. longis, velut ramulis novellis pilosis; laminis papyraceis oblongo-ovatis, 10–14 cm. longis, 4.5–5.5 cm. latis, basi obtusis vel subacutis, apice acuminatis (acumine 5–15 mm. longo), margine integris saepe sinuatis, utrinque glabris (costa saepe puberula), copiose pel-

lucido-punctatis, pinnatinerviis, nervis lateralibus 5–7-jugis arcuato-adscendentibus prope marginem anastomosantibus, cum costa supra leviter elevatis subtus prominentibus, venulis copiose reticulatis elevatis vel planis; inflorescentiis ♀ cymosis, cymis in foliorum axillis 1 vel 2 paucifloris 12–20 mm. longis, ubique parce cinereo-stellulato-puberulis; pedicellis 2.5–4.5 mm. longis; floribus ♀ subrugosis, maturitate 2 mm. diametro; receptaculis subglobosis, tepalis omnino obsoletis; velo glabro conico-elevato circiter 0.5 mm. longo, ore minuto; stylis ad apices firme connatis, 0.5–0.7 mm. exsertis; carpellis plerumque 5 vel 6.

Type, *Krukoff 1682*, collected Dec. 27, 1931, on "terra firma" near the source of the Jatuarana River, Machado River region, State of Matto Grosso. It is related to *S. micrantha* A. DC., from which it differs by having the leaves proportionately broader and with fewer lateral nerves, and the styles, which are connate to the apices, strongly exserted.

Rosaceae

Parinarium Krukovii Gleason, sp. nov. Arbor, ramulis teretibus rugosis glabris griseis; petioli vetustiores 4–6 mm. longi glabri rugosi eglandulosi, supra canaliculati; foliorum laminae tenuiter coriaceae anguste ellipticooblongae 6–9 cm. longae 2–3 cm. latae, basi acutiusculae, ad apicem acutam abrupte acuminatae, supra glabrae lucidae costa prominente, venis secundariis planis obscuris, venulis arctissime reticulatis et levissime impressis, subtus ad costam validam prominentem et venas secundarias utrinque 10–12 sub angulo 50° orientes subrectas prope marginem curvato-adscendentes glabrae, ad paginam tenuissime canescentes; panicula fructifera terminalis pauciramosa foliis brevior axibus jam velut ramulis lignosis; drupa fusca ellipsoidea ad 25 mm. longa, apice rotundata, saepe subfalcata.

Type, *Krukoff 1362*, collected Nov. 15, 1931, on "terra firma," near Tabajara, upper Machado River region, State of Matto Grosso. It is related to *P. brasiliense* Hook. f., *P. Pohlii* Hook. f., and *P. Glaziovianum* Warm., differing from all of them in the glabrous branches, the glabrous midvein, and the lack of conspicuous pubescence on the lower side of the leaves.

Connaraceae

Rourea rectinervia A. C. Smith, sp. nov. Frutex scandens; ramulis subteretibus fusco-puberulis mox glabrescentibus; foliis (petiolis inclusis) 25–45 cm. longis, 7- vel 9-foliolatis; rhachidibus robustis velut ramulis puberulis, petiolis 5–14 cm. longis basi incrassatis; foliolis coriaceis concoloris subopppositis, paribus 2.5–4.5 cm. distantibus, eis inferioribus minimis, breviter petiolulatis (petiolulis rugosis 4–6 mm. longis), oblongis vel obovato-oblongis, maximis ad 18 cm. longis et 7.5 cm. latis, basi subacutis, apice cuspidatis vel breviter acuminatis, margine integris, supra glabris subtus nervis principali-

bus puberulis, costa crassa supra valde impressa subtus prominentissima, nervis lateralibus 5- vel 6-jugis rectis adscendentibus prope marginem anastomosantibus supra impressis subtus prominentibus, venulis copiose reticulatis subtus leviter elevatis; inflorescentiis 1 vel 2 in axillis foliorum paniculatis, 7–15 cm. longis, ramulis minute fusco-puberulis; calyce maturo puberulo coriaceo subsessili, lobis erectis imbricatis ovatis, circiter 2 mm. longis et 4 mm. latis, rotundatis; capsula curvata 12–14 mm. longa, stylo saepe persistente.

Type, *Krukoff 1660*, collected Dec. 22, 1931, on shore of creek near the source of the Jatuarana River, Machado River region, State of Matto Grosso. The ascending nerves, which are deeply impressed above and prominent beneath, distinguish the species. From *R. frutescens* Aubl., probably its closest ally, the new species is also distinguished by the minutely puberulent rather than griseo-sericeous pubescence.

Caesalpiniaceae

Tachigalia carinata Gleason, sp. nov. Arbor 12 m. alta, ramulis crassis glabris; stipulae ad bases foliorum et inflorescentiae ramorum atque nodos superiores sine foliis conspicuae persistentes foliaceae, pinnatifidae lobis 3–7, ambitu late ovatae, 10–15 mm. longae, tenuiter canescentes, lobis anguste lanceolatis acuminatissimis, lobo terminali laterales fere aequante; folia paripinnata 7–9-juga; petiolus 3.5–6 cm. longus, crassus, in formicarium leviter dilatatus, supra planus aut subconvexus lateribus carinatis, subtus carinatus vel subrotundatus, glaber; rachis 18–38 cm. longa, minutissime adpresseque puberula, supra plana lateribus carinatis, subtus rotundata vel subcarinata; foliola inter se 25–50 mm. dissita, infima 2 ovata vel ovato-oblonga, 5–12 cm. longa, fere aequilatera, cetera oblongo-lanceolata vel oblonga, 12–18 cm. longa, 4–5.5 cm. lata, basi obtusa vel subrotundata, apice anguste longeque acuminata, utrinque glabra, nervo medio margine inferiori propiore, supra paullum, subtus bene prominente, nervis lateralibus utrinque 7–10 sub angulo 50° orientibus, marginem versus arcuatis et arcuatim connexis, petiolulis atris rugosis 3–4 mm. longis; inflorescentia terminalis vix paniculata, ramis 2–8 elongatis virgatis, rhachide sicut pedicellis hypanthio calyceque arcte canescenti-tomentula, parte inferiore 5 cm. longa sterili; alabastra et flores conferti ad anthesin 2–3 mm. dissiti; bracteae canescentes erectae anguste lanceolatae longissime acuminatae 4 mm. longae, ad anthesin deciduae; pedicelli crassiusculi 3–3.5 mm. longi; hypanthium obconicum paullum obliquum 10-costatum 3–3.5 mm. longum; sepala 5 ad anthesin reflexa apice rotundata, intus canescenti-villosula, exteriora 2 oblonga, 5 mm. longa 3.5 mm. lata, interiora 3 tenuiora 6 mm. longa 5.5 mm. lata; petalum superius obovatum apice rotundatum 7 mm. longum 5 mm. latum, petala 4 lateralia et inferiora oblonga obtusa 7 mm. longa 3.5 mm. lata, omnia intus prope basin villosa; stamina majora 7 leviter sigmoidea angustissime subulata 11 mm. longa, in parte tertia inferiore ferrugineo-villosa, minora 3 crassiora 9 mm. longa, ceterum

similia; ovarium ad hypanthium excentrice adnatum, stipite villoso 2 mm. longo elevatum, oblongum complanatum 3.5 mm. longum pubescens, stylo gracili 9–10 mm. longo.

Type, *Krukoff 1479*, collected Nov. 28, 1931, on varzea land along river near Tabajara, upper Machado River region, State of Matto Grosso. It is most closely related to *T. formicarium* Harms, from eastern Peru, in which the stipules are somewhat larger, with reduced lateral lobes, the leaflets only 4–6 pairs, the shorter spikes only 5–10 cm. long and ferruginous instead of canescent, and the petals only 4 mm. long and actually shorter than the sepals.

ELIZABETHA PARAENSIS Ducke. Two specimens have been distributed under this name, *Krukoff 1167* and *1184*, both from the upper Cupary River, State of Pará, the first in flower, the second sterile. The leaflets of the sterile specimen are larger, up to 25 mm. long, with veins more conspicuous on both surfaces, the rachis is more pilose, and the leaves are subtended by large protective scales 5 cm. long. The leaflets of the fertile plant are rarely more than 18 mm. long and the scales are replaced by intrapetiolar stipules 5–8 mm. long. Certain individual specimens of *1184*, however, have leaflets scarcely longer than those of *1167*. Ducke noted the variation in size of leaflets also, and it is probable that large leaflets, protective scales, and pubescent habit are characteristic of rapidly growing parts of the plant. Ducke's original description was apparently based on fruiting material bearing young buds. In certain points of floral structure, our specimens differ notably from the original, but the discrepancies can be easily accounted for by further development of the parts. The following addition to the original description is offered:

Bracteae oppositae 20 mm. longae usque medium connatae, parte libera ovata obtusa, apice inflexa vel cucullata; pedicelli 13 mm. longi; hypanthium coriaceum campanulatum, 6.5 mm. longum; sepala 4 mox decidua, ad hypanthium discreta, 16–19 mm. longa, 7–11 mm. lata, ovato-oblonga, paullum falcata, obtusa; petala 5 fere aequalia, anguste oblongo-elliptica, 22 mm. longa, 7–8 mm. lata; stamina fertilia 3, circa 5 cm. longa, sterilia 6, 16–22 mm. longa.

FABACEAE

Diplotropis triloba Gleason, sp. nov. Arbor 30-metralis; rami juniores crassiusculi subteretes minutissime puberuli; petioli 30–45 mm. longi, tenuissime puberuli, rhachis foliorum ultra petiolum 9–11 cm. longa; foliola 9 firma ovali-oblonga 6–8 cm. longa 4–4.5 cm. lata acuta, basi rotundata et paullulum obliqua, supra glabra subnitentia, costa impressa, venis venulisque paullum elevatis distincte reticulatis, subtus opaca in sicco brunnescentia minutissime puberula, venis indistinctis; panicula magna floribunda e ramis terminalibus

et in axillis superioribus orientibus composita arcte puberula aut fere velutina, pilis brevibus brunneis, bracteis persistentibus late triangularibus apice incurvis 1 mm. longis; flores in ramis racemosi pedicellis velutinis adscendentibus 4 mm. longis, bracteolis ad basin hypanthii minutis ovatis; hypanthium et calyx falcato-campanulatus velutinus latere posteriore fere 10 mm. longo inferiore breviore; sepala falcato-triangularia acuta 2–3 mm. longa, posteriora quam anteriora paullum longiora; petala omnia libera unguiculata; vexillum 9 mm. longum, supra unguem brevem ad 6 mm. explanatum et fere trilobum, lobis lateralibus triangularibus ad apicem auriculatis, lobo terminali late oblongo rotundato; petala alaria 12 mm. longa, ungui 5 mm. longa, lamina oblonga apice rotundata basi truncata; petala carinalia 12 mm. longa valde inequilatera; stamina 10 alternatim inaequalia 3.5 vel 6 mm. longa, filamentis subulatis glabris; ovarium oblongum 5 mm. longum velutinum; stylum 5 mm. longum apice incurvatum.

Type, *Krukoff 1562*, collected Dec. 7, 1931, on "terra firma" near the source of the Jatuarana River, Machado River region, State of Matto Grosso. An immature pod is 4 cm. long and 8 mm. wide. A second specimen is *Krukoff 1380*, collected near Tabajara, in the upper Machado River region; its leaves are slightly larger and less plainly reticulate above and the pubescence of the inflorescence and calyx is shorter and somewhat sparser. The flower structure is the same. The conspicuously lobed vexillum indicates that the relations of *D. triloba* are with *D. brasiliensis* (Tul.) Benth., which has smaller leaflets prominently reticulate on both sides, a shorter, wider, and less pubescent calyx, and much shorter pedicels.

RUTACEAE

Erythrochiton delitescens Morton, sp. nov. Subg. *Toxosiphon;* frutex erectus; ramuli perspicue rugosi, ca. 25 mm. diametro, glabri, nitidi, internodiis abbreviatis, saepe vix 1 cm. longis; folia solitaria, unifoliolata; petioli usque 7 cm. longi, ca. 1.5 mm. diametro, graciles, glabri, supra evidenter canaliculati, haud teretes, apice articulati; laminae oblanceolatae, maximae 24 cm. longae et 8.7 cm. latae, apice abrupto brevi-acuminatae, basi acuminatae, membranaceae, in statu sicco pallide virides, concolores, integrae, inconspicue glanduloso-punctatae, venis lateralibus primariis (ca. 12) arcuatis et anastomosantibus, intermediis numerosis et prominentibus, venulis copiose reticulatis; pedunculus ut videtur terminalis, usque 11.5 cm. longus, apice furcatus, ca. 6-florus, sulcatus, puberulus, pilis minutis albis, simplicibus, apicem spectantibus, appressis dense obsitus; pedicelli 6–9 mm. longi, apicem versus incrassati, dense puberuli; calyx valvatus, usque ad basin partitus, valde angulatus, lobis 5, lanceolatis, alabastro margine recurvatis, ca. 3 cm. longis, 7 mm. latis, apice longe et gradatim acuminatis, basi paullum angustatis, utrinque dense albido-puberulentis, haud glanduloso-punctatis; corolla ex 5 petalis liberis constata, petalis basi plus minus cohaerentibus, albis, linear-

spathulatis, ca. 5 cm. longis, usque 6 mm. latis, basi valde angustatis, ca. 3 mm. latis, apice acutis, utrinque dense albido-puberulis, imbricatis; stamina antherifera 2, filamentis brevibus, glabris, antheris linearibus, ca. 9 mm. longis, longitudinaliter dehiscentibus, connectivo magno basi valde dilatato et in auriculis binis producto; stylus ca. 4 mm. longus, basi glaber, sursum dense pubescens; stigmata 5, libera, capitata; gynoecium ex 5 carpellis liberis glabris constatum, ovulis binis ex angulo interiore carpellorum pendulis, superpositis; fructus deest.

Type, *Krukoff 1598*, collected Dec. 21, 1931, in a very old clearing near the source of the Jatuarana River, Machado River region, State of Matto Grosso. Form any years *Erythrochiton Lindenii* (Baill.) Hemsl. of North America was the only known member of the subgenus *Toxosiphon*. In 1905, however, Pilger[1] described *E. trifoliatum* from the Department of Loreto, Peru. Since then one additional species, *E. macropodum* Kraus, has been described. The present species differs from *E. trifoliatum* in its unifoliolate rather than trifoliolate leaves. It differs from *E. macropodum* in its densely puberulent, eglandulose sepals.

Galipea tubiflora A. C. Smith, sp. nov. Frutex 8 m. altus; ramulis teretibus glabris striatis; petiolis teretibus basi incrassatis 3–12 cm. longis; foliis 3-foliolatis, petiolulis 1–2 cm. longis; laminis papyraceis viridibus glabris dense pellucido-punctatis inaequilateralibus (terminali aequilaterali et majore) oblongis, 25–35 cm. longis, 8–11 cm. latis, basi acutis, apice caudato-acuminatis (apice ipso obtuso), margine integris saepe undulatis, pinnatinerviis, costa utrinque prominentissima, nervis lateralibus 10–15 in quoque latere arcuato-adscendentibus prope margines anastomosantibus, utrinque elevatis, venulis copiose reticulatis conspicuis; inflorescentiis axillaribus quam foliis brevioribus, rhachide tereti apicem versus complanata, ramulis brevibus floriferis apice inflorescentiae congestis, juventute luteo-pulverulentis; pedicellis circiter 1 mm. longis; calyce cupuliformi 4 mm. longo minute pulverulento parce glanduloso bevissime dentato; corolla maturitate 3–4 cm. longa, tubo 3 mm. diametro extra glanduloso et minutissime pulverulento intus basi filamentorum albo-villoso, lobis subaequalibus oblongo-lanceolatis, maturitate recurvatis 15 mm. longis et 2.5 mm. latis, apice calloso-mucronatis; staminibus ut videtur 5 fertilibus, filamentis ligulatis, antheris lineari-oblongis 3–4 mm. longis, basi appendicibus cordatis carnosis 2 mm. longis instructis; disco membranaceo 0.8 mm. longo margine puberulo ovarium cingente; ovario depresso-globoso, loculis plus minusve distinctis ut videtur 1-spermis; stylo glabro corollam subaequante, stigmate incrassato; capsula 5-loculari, carpidiis striatis oblongo-ovoideis circiter 13 mm. longis, dorso obtuse carinatis.

Type, *Krukoff 1538*, collected Dec. 5, 1931, on "terra firma" near

[1] Verh. Bot. Ver. Brandenburg 47: 153. 1905.

Angustura, near the source of the Jatuarana River, Machado River region, State of Matto Grosso. In leaf shape and size, the new species resembles *G. longiflora* Krause, which, however, has a toothed calyx and densely pilose flowers. *G. tubiflora* is probably more closely allied to *G. jasminiflora* (St. Hil.) Engl., from which it differs in its narrower corolla lobes, longer anther connectives, larger leaves, etc. All the flowers of *G. tubiflora* which I have examined have five fertile anthers, whereas the above species have only two.

Esenbeckia coriacea A. C. Smith, sp. nov. Arbor; ramis ramulisque teretibus glabris fuscis vel cinereis rugosissimis copiose lenticellatis; petiolis velut ramulis, 2–4 cm. longis; foliis 2- vel 3-foliolatis, petiolulis incrassatis circiter 2 mm. longis cum petiolis articulatis, laminis coriaceis glabris pellucido-punctatis inaequilateralibus (praeter terminales) oblongis, 12–20 cm. longis, 5–8 cm. latis, basi acutis, apice breviter acuminatis (apice ipso obtuso), margine integris et leviter recurvatis, pinnatinerviis, costa crassa supra leviter elevata subtus prominentissima, nervis lateralibus circiter 12-jugis patulis, prope margines adscendentibus et anastomosantibus, utrinque elevatis, venulis anastomosantibus subtus conspicuis; inflorescentiis terminalibus paniculatis, ramis juventute puberulis, bracteolis deciduis coriaceis acutis 1–2 mm. longis subtentis; floribus utrinque dense pallide puberulis; pedicellis 1.5–3 mm. longis prope basin minute bibracteolatis; calyce 5-lobato, lobis deltoideis obtusis, circiter 0.8 mm. longis et 1.2 mm. latis; petalis 5 albis carnosis ovato-oblongis, circiter 3.7 mm. longis et 2 mm. latis, basi angustis, apice acutis; staminibus 5 glabris, filamentis carnosis circiter 2 mm. longis, distaliter contractis, antheris dorsifixis versatilibus ovoideis, circiter 0.8 mm. longis, basi subcordatis, apice apiculatis; disco 10-lobato, dense carnoso-tuberculato; stylo carnoso circiter 0.8 mm. longo, stigmate 5-lobato; fructu glabro, maturitate 3 mm. longo et 4 mm. diametro, rugosissimo, loculis 1-spermis.

Type, *Krukoff 1667*, collected Dec. 23, 1931, on "terra firma" near the source of the Jatuarana River, Machado River region, State of Matto Grosso. Other collections are: *Rusby 2617*, *2663*, both from the Falls of the Madeira River, State of Amazonas. It is a species related to the Andean *E. alata* (Karst. & Tr.) Tr. & Pl., compared with which it has the leaf-blades more coriaceous, the calyx-lobes shorter, and the mature fruit larger and more conspicuously rugose.

Zanthoxylum Krukovii A. C. Smith, sp. nov. Arbor ad 30 m. alta, trunco 1 m. diametro; ramulis subteretibus rugosissimis glabris fuscis, prope apices 4–6 mm. diametro; foliis adscendentibus 15–30 cm. longis, petiolis rhachidibusque purpurascentibus striatis juventute cinereo-puberulis ,petiolis 3–6 cm. longis basi incrassatis et semiteretibus, rhachidibus teretibus, internodiis 1–3 cm. longis; foliolis 4–7-jugis, petiolulis gracilibus rugosis puberulis 4–6 mm. longis, laminis subcoriaceis praeter nervos subtus glabris dense et conspicue

pellucido-punctatis oblongis vel ovato-oblongis, 6–9 cm. longis (eis basis brevioribus), 2.5–3.5 cm. latis, basi inaequilateraliter cuneatis, apice breviter et obtuse acuminatis, margine integerrimis, costa supra impressa subtus prominente, nervis lateralibus primariis 8–12 in quoque latere patulis prope margines anastomosantibus utrinque elevatis, venulis copiose reticulatis elevatis; inflorescentiis terminalibus paniculatis ad 20 cm. longis et latis multifloris, ramulis teretibus striatis puberulis, bracteis minutis deciduis subtentis, ramulis extimis brevibus; floribus ♂ in glomerulis 3–5-floris congestis sessilibus, basi 3 vel 4 bracteis ovatis 0.6 mm. longis margine minute fimbriatis circumdatis; calycis lobis 5 imbricatis ovato-deltoideis circiter 0.7 mm. longis et latis; petalis 5 anguste imbricatis submembranaceis albis ovatis, circiter 1.5 mm. longis et 0.9 mm. latis, apice subacutis; staminibus 5 corollam subaequantibus, filamentis teretibus, antheris ovoideis cordatis 0.7 mm. longis; ovarii rudimento breviter conico sulcato stigmatibus 3 sessilibus coronato.

Type, *Krukoff 1587*, collected Dec. 20, 1931, on "terra firma" near the source of the Jatuarana River, Machado River region, State of Matto Grosso. It is a species related to *Z. cuiabense* Engl., than which it has more numerous, narrower, and more conspicuously punctate leaflets. *Z. Krukovii* has the flowers absolutely sessile, the stamens equaling rather than exceeding the petals, and the rudimentary ovary 3- rather than 2-parted.

Meliaceae

Trichilia punctata A. C. Smith, sp. nov. Frutex; ramulis elongatis teretibus striatis glabris copiose lenticellatis; foliis alternis 25–45 cm. longis, petiolis decidue pilosis, 4–7 cm. longis, canaliculatis bialatis, rhachidibus leviter canaliculatis striatis, foliolis plerumque 9 suboppositis, petiolulis rugosissimis 4–5 mm. longis (foliolae terminalis 5–15 mm. longis), laminis coriaceis fuscis dense pellucido-punctatis oblongis, 8–17 cm. longis, 3–6 cm. latis, basi subattenuatis, apice cuspidatis, margine subintegris et leviter recurvatis, utrinque glabris, pinnatinerviis, nervis lateralibus 13–15-jugis patulis prope margines adscendentibus, cum costa supra leviter impressis subtus prominentibus, venulis copiose reticulatis; paniculis axillaribus quam petiolis brevioribus e basi 2- vel 3-fidis, ramulis dense cinereo-pilosis; floribus sessilibus, bracteis pilosis deltoideis 1 mm. longis subtentis; calyce 5-dentato, dentibus deltoideis acutis 0.7 mm. longis parcissime puberulis; petalis 5 haud imbricatis oblongis obtusis, 3.3–4 mm. longis, circiter 1.8 mm. latis; staminibus 10–12, in fructu saepe persistentibus; filamentis fere ad medium connatis, circiter 1.6 mm. longis, superne pilosis; antheris obtusis, circiter 0.5 mm. longis, pilis 0.3 mm. longis dense hirsutis; ovario sessili conico sub anthesi 1.5–2 mm. longo, dense adpresso-albo-hirsuto, 3-loculari, loculis 1-spermis; stigmate subsessili (stylo ad 0.3 mm. longo), discoideo; capsulis ovoideis vel trigonis, maturitate ad 25 mm. longis et 10 mm. diametro, minute velutinis, 3-spermis, seminibus collateralibus arillo vestitis.

Type, *Krukoff 1437*, collected Nov. 24, 1931, on varzea land near shore of river near Tabajara, upper Machado River region, State of Matto Grosso. It is a species of the section *Eutrichilia*, allied to *T. guianensis* Kl., compared with which it has the inflorescence more compact and fewer flowered, and the stigma subsessile (*T. guianensis* has a noticeable style). In foliage, our species has the leaves 4-jugate rather than 3-jugate, the leaflets more coriaceous and pellucid-punctate, and the nerves impressed rather than plane above.

Trichilia Krukovii A. C. Smith, sp. nov. Arbor circiter 13 m. alta, trunco prope basin 0.5 m. diametro; ramis ramulisque subteretibus rugosis juventute arcte fusco-puberulis; foliis ad 60 cm. longis, petiolis velut ramulis decidue puberulis, 8–10 cm. longis, crassis (3–5 mm. diametro), inferne 2-alatis, rhachidibus teretibus, foliolis 7 vel 9 suboppositis, petiolulis rugosis incrassatis 3–5 mm. longis (foliolae terminalis ad 30 mm. longis), laminis coriaceis oblongis, 12–23 cm. longis, 3.5–8 cm. latis, basi acutis vel cuneatis, apice cuspidatis vel breviter acuminatis, margine crenulatis et recurvatis, supra fuscis et praeter costam puberulam glabris, subtus pallidis minute puberulis mox glabris, pinnatinerviis, nervis lateralibus 14–22-jugis rectis patulis prope margines adscendentibus, cum costa supra planis subtus prominentibus, venulis copiose reticulatis; paniculis multifloris axillaribus quam foliis brevioribus (ad 20 cm. longis et 10 cm. latis), ramulis angulatis striatis dense cinereo-puberulis; floribus pedunculis brevibus subsessilibus, extra subtilissime argenteo-puberulis demum glabrescentibus: calyce 5-lobato, lobis late ovatis, 1.5 mm. longis, 1.8 mm. latis, basi angustioribus; petalis 5 aestivatione quincuncialibus oblongis, circiter 3.7 mm. longis et 2 mm. latis, apice obtusis; filamentis connatis, tubo stramineo utrinque puberulo 1.5 mm. longo, margine inter antheras dentes lanceolatos 0.8 mm. longos gerente; antheris 10 subacutis 1.2 mm. longis; ovario sessili subgloboso sub anthesi circiter 2 mm. diametro, dense et arcte albo-hirsuto, 3-loculari, loculis 1-spermis; stylo carnoso 0.5 mm. longo apice incrassato 3-denticulato.

Type, *Krukoff 1021*, collected Sept. 5, 1931, on "terra firma" at Fordlandia, Tapajos River region, State of Pará. It is a species of the section *Moschoxylum*, related to *T. septentrionalis* C. DC., from which it differs by its thicker leaves, smaller panicles, larger flowers, and hirsute rather than glabrous ovaries.

Cabralea erismatica A. C. Smith, sp. nov. Arbor ad 30 m. alta, prope basin 0.5–1 m. diametro; ramulis subteretibus glabris fuscis; foliis glabris alternis 50–80 cm. longis, petiolis rhachidibusque subteretibus, petiolis basi incrassatis, foliolis plerumque 9–11-jugis suboppositis, petiolulis rugosis 4–7 mm. longis, laminis papyraceis viridibus epunctatis falcato-oblongis, 12–19 cm. longis (eis basis paullo brevioribus), 3.5–5.5 cm. latis, basi inaequilateraliter cuneatis, apice longe acuminatis, margine integris vel undulatis, costa leviter

curvata utrinque prominente, nervis lateralibus primariis 10–15 in quoque latere patulis prope margines adscendentibus utrinque leviter elevatis, venulis reticulatis subplanis; paniculis axillaribus quam foliis brevioribus (15–35 cm. longis) pedunculatis multifloris, ramulis striatis, ultimis breviter cinereo-strigosis; floribus pedicellatis (pedicellis ad 3 mm. longis), bracteis pilosis minutis subtentis; sepalis 5 imbricatis late ovatis rotundatis circiter 2 mm. longis et 2–3 mm. latis, extra puberulis, margine membranaceis et fimbriatis; petalis 5 haud imbricatis submembranaceis parce puberulis oblongis obtusis, 7–8 mm. longis, circiter 3 mm. latis; filamentis connatis, tubo carnoso glabro cylindrico circiter 6 mm. longo, apice crenato, antheris oblongis obtusis 1 mm. longis, dorso prope basin sessilibus; disco carnoso tubuloso erecto 2 mm. longo, extra glabro, intus dense strigoso, apice incrassato et crenato; ovario sessili arcte strigoso conico sub anthesi 1.5–2 mm. longo, 5-loculari, loculis 2-ovulatis; stylo crasso 5 mm. longo basi puberulo, stigmate carnoso discoideo 1 mm. diametro.

Type, *Krukoff 1115*, collected Sept. 14, 1931, in high forest in the region of the upper Cupary River, on the plateau between the Xingu and Tapajos Rivers, State of Pará. Another collection from the same region is *Krukoff 1121*. It is said to be a large tree with conspicuous buttresses; the outer bark of the trunk is thick and ashy-gray, the inner bark being reddish-brown. It is locally known as "Cedrahy." It is probably most nearly allied to *C. laevis* C. DC., which has considerably smaller leaves and leaflets, but of which the flowers are undescribed. No species of *Cabralea* have previously been described from this part of the Amazon basin, the genus being best developed farther south.

Malpighiaceae

Alcoceratothrix. Niedenzu separated the genus *Alcoceratothrix* from *Byrsonima* chiefly because of the structure of the hairs, which in the segregate are wholly or partially branched and "alcis cornua imitantes." We are scarcely disposed to agree with a generic segregation on such grounds, but distribute the material under Niedenzu's name to conform with the usage in his recent monograph of the family. Of the two species, *A. stipulacea* has trimorphic hairs and non-glandular sepals, while *A. rugosa* is stated to have one form of hairs only and glandular sepals.

In *Krukoff 1555* the sepals are non-glandular and the hairs trimorphic; it has been referred accordingly to *A. stipulacea*. In comparison with *Martius 567* cited by Niedenzu, its leaves are less pubescent on both sides, the upper internodes velutinous rather than hirsute, and the persistent stipules only 9–10 mm. long.

In *Krukoff 1360* the sepals are glandular and the whole habit is that of the well known *A. rugosa*, represented in our herbarium by numerous

specimens from Guiana. While Niedenzu states that the hairs are only a fourth of a millimeter long, in almost all of our specimens, including some cited by Niedenzu, they surpass a millimeter and even reach 3 mm. on the stipules, while the elk-horn hairs are distributed chiefly on the lower side of the leaves and in the inflorescence. *Krukoff 1360* has such hairs limited to the inflorescence and sepals, and bears on the lower side of the leaf simple vertical hairs 1 to 15 mm. long.

VOCHYSIACEAE

Erisma parvifolium Gleason, sp. nov. Arbor excelsa ad 30 m. alta, ramulis teretibus, cortice cinereo tenui mox exfoliato et brunnescente, ramulis novellis gracilibus 4-sulcatis fuscis tenuiter stellato-tomentellis, internodiis 15–50 mm. longis; folia opposita vel verticillata; petioli crassi 3–6 mm. longi, ut ramulis utrinque tomentelli et supra breviter brunneo-pilosi; laminae subcoriaceae anguste oblongae 8–13 cm. longae 2.5–5.5 cm. latae, in apiculam brevem abrupte acuminatae, margine integro paullum (tantum in sicco) revolutae, basi obtusae vel rotundatae, supra pallide virides subnitentes, subtus fuscae tenuissime stellato-pubescentes et ad venas venulasque parce pilosae; costa supra impressa; venae secundariae supra leviter impressae subtus elevatae, rectiusculae, prope marginem arcuatim conjunctae, venulis inconspicuis utrinque tenuissime reticulatis elevatisque; panicula ampla ramosa terminalis, 1–2 cm. longa tenuiter stellato-pubescens, cicinnis 3–5 floris rectiusculis vel leviter flexuosis; bracteae majores foliaceae oblique rotundato-ovatae 7–8 mm. longae 6–6.5 mm. latae sessiles minute stellato-pubescentes, obscure venosae; bracteae minores oblanceolatae 4–5 mm. longae, 1.5 mm. latae, acutae vel acuminatae, ad basin cuneatae, molliter pubescentes; flores solitarii in axilla cujusque bracteae minoris, pedicello 3 mm. longo; sepala basi connata oblonga, parte libera sepalis primi et quinti 2.5 mm. longa acuta, secundi et tertii 3.5–4 mm. longa obtusa, omnia subcarnosa molliter stellato-pubescentia; sepalum quartum petaloideum rotundatum 9 mm. longum, ad basin purpureo-pilosum, infra basin in calcar anguste subulatum ab ovario pedicelloque liberum 5–6 mm. longum angustatum, post anthesin deciduum, basi persistente poculiformi; petalum unicum triangulari-obovatum 18 mm. longum, basi cuneatum, superne bilobum, lobis obtusis 4 mm. longis; stamen unicum, filamento gracili 6.5 mm. longo, anthera lanceolata extrorsa 2.8 mm. longa, dorso affixa; ovarium inferum, ovulis 2, stylo subulato 6 mm. longo, post anthesin paullum supra basin deciduo, stigmate ovoideo capitato 0.5 mm. longo; pedicelli fructiferi leviter incrassati 5 mm. longi; sepala post anthesin accrescentia et cum ovario samaram formantia, sepalo quarto breviter calcarato incurvato puberulo 3 mm. longo, ceteris chartaceis reticulato-venosis utrinque minutissime stellato-puberulis, primo recto 10 mm. longo, secundo oblongo inequilatero 20 mm. longo, tertio oblongo leviter falcato 60 mm. longo, quinto falcato-ovato 8 mm. longo; nux glabra compressa 1 cm. longa tota longitudine ad calycem adnata; stylus persistens 4 mm. longus.

Type, *Krukoff 1401* (with flowers and immature fruit), collected Nov. 23, 1931, on "terra firma" near Tabajara, upper Machado River region, State of Matto Grosso. *Krukoff 1332*, collected at the same place, is identical. *Krukoff 1679*, collected at the source of the Jatuarana River, Machado River region, is in fruit; its leaves are notably smaller, measuring 5–10 cm. long and 18–32 mm. wide. In all details of pubescence and venation it agrees with the flowering specimens, and the upper leaves of the latter are also similar in their dimensions.

Although most of the ten described species of *Erisma* are rather poorly known, the foliar characters alone are sufficient to separate our species, which is distinct in its narrow leaves pubescent on the lower surface. It clearly stands nearest to *E. uncinatum* Warm., which has much longer petioles, longer and proportionately wider leaf-blades cuneate to the base, smaller bracts, very short pedicels, smaller flowers, acuminate sepals, and a large hooked spur.

Erisma petiolatum Gleason, sp. nov. Arbor ad 25 m. alta; ramuli juveniles tenuissime ferrugineo-tomentelli, inter nodos leviter compressi, mox teretes, glabri, et purpurascentes; folia opposita; petioli crassissimi tomentelli 2–2.5 cm. longi, supra alte canaliculati, ad lateres argute angulati; laminae subcoriaceae, elliptico-oblongae, 20–28 cm. longae, 7–10 cm. latae, ad apicem rotundatam et in apiculam acuminatam 1–2 cm. longam productae, infra medium ad basin rotundatam sensim angustatae, supra glabrae, subtus minutissime stellato-puberulae, costa supra impressa, subtus prominente, venis secundariis supra obscuris, subtus elevatis rectis, imum ad marginem arcuatim connexis; venulis utrinque arctissime reticulatis; panicula 2 dm. longa, ferruginea, divaricato-ramosa; cicinni oppositi et ad apicem aggregati, 2–5 mm. pedunculati, circa 5-flori, jam immaturi; bracteae majores rotundato-ovatae, paullum inequilaterae, 6–7 mm. longae, 4–4.5 mm. latae, tenuissime pubescentes; bracteae minores lineari-subulatae, 1 mm. longae; pedicelli 1.5 mm. longi; sepala more generis inaequales, calcare crasso obtuso erecto, in alabastro 1.6 mm. longo.

Type, *Krukoff 1334*, collected Nov. 12, 1931, on "terra firma" near Tabajara, upper Machado River region, State of Matto Grosso. *Krukoff 1376*, from the same place, differs only in a slightly less developed acumen on the leaves. Notwithstanding the lack of mature flowers and fruit, and the risk of burdening literature with a synonym, I feel confident that these specimens represent an unrecognized species. The last treatment of the genus, by Warming, is nearly fifty years old, and only one species has been described since then. Warming distinguished two sections, the first with the lower bracts much larger than and concealing the upper, the second with bracts more nearly uniform in size. While our species belongs

to the second group, foliar differences also exist which separate it from the two known species of the first. In the second group, *E. Japura* has the spur adnate to the ovary and pedicel and the leaves are retuse; *E. calcaratum* has a pendent spur, small leaves, short petioles, and poorly developed marginal vein; *E. uncinatum* differs in the size and shape of its leaves and notably in the peculiar shape of its spur; *E. nitidum* has about half as many secondary veins which are arcuately joined far inside the margin and the petioles are much shorter; *E. micranthum* has much smaller leaves without a connecting marginal vein and a deflexed spur. In *E. fuscum* Ducke, recently described, the leaves are short-petioled, broadly obovate, and glabrous.

EUPHORBIACEAE

Sapium leitera Gleason, sp. nov. Arbor 8 m. alta glabra; ramuli graciles tenuiter striati ad apicem nodorum lenticellis ellipticis ornati; folia irregulariter alterna vel subopposita; stipulae parvae coriaceae ovatae mox deciduae; petioli graciles 3–4 cm. longi striati apicem versus glandula una rugosa notati; laminae chartaceae late ellipticae 9–14 cm. longae, 6–8 cm. latae, apice rotundatae vel paullo emarginatae, margine anguste cartilagineo incrassatae, infime late rotundatae ad basin cordatam, venis lateralibus utrinsecus circa 16, sub angulo 70° orientibus, arcuato-adscendentibus et prope marginem curvatis, supra distinctis planis, subtus elevatis, venis secundariis utrinque reticulatis; spicae terminales in fructu 5 cm. longae; capsulae stipite crasso pyramidato angulato 2 mm. longo insidentes, late obovoideae vel pyriformes, basi angustatae, 18 mm. longae glabrae 6-angulatae, stylo deciduo, parietibus crasse crustaceis; semina 3, obovoidea, 5.5 mm. longa, a hilo quadrangulari ad summum columellae affixa, pseudo-arillo brunneo rugoso obtecta.

Type, *Krukoff 1656*, collected Dec. 22, 1931, on "terra firma," near the source of the Jatuarana River, Machado River region, State of Matto Grosso. A vernacular name is "Burra leitera." The specimen is apparently identical with flowering specimens collected by Steinbach in Bolivia and distributed under the name *Sapium peloto* Pax & Hoffm.

HIPPOCRATEACEAE

Salacia mauritioides A. C. Smith, sp. nov. Frutex scandens glaber; ramis ramulisque teretibus cinereis vel fuscis; petiolis crassis rugosis canaliculatis 15–25 mm. longis; laminis coriaceis olivaceis oblongis, 16–25 cm. longis, 6–12 cm. latis, basi obtusis vel cuneatis, apice acutis, margine integris et leviter recurvatis, utrinque parcissime nigro-punctatis ac etiam subtus squamas luteas minutas densius gerentibus, costa utrinque prominentissima, nervis lateralibus primariis 7–10 in quoque latere arcuato-adscendentibus prope margines anastomosantibus utrinque elevatis, venulis anastomosantibus plus minusve immersis; cymis axillaribus ad 3 cm. longis et latis, supra basin divisis, ramis dichotome ramulosis angulatis bracteatis, bracteis suboppositis del-

toideis minutis; floribus subsessilibus (pedicellis ad 0.5 mm. longis), ubique minutissime ferrugineo-puberulis, maturitate 2.5 mm. diametro; sepalis parvis deltoideis subacutis, 0.5 mm. longis, 0.8 mm. latis, margine eroso-ciliatis; petalis tenuiter carnosis obovato-oblongis, 1.5 mm. longis, 1 mm. latis, margine eroso-fimbriatis; disco breviter tubuloso erecto, 0.4 mm. longo, margine integro; staminibus 3 erectis, filamentis gracilibus 0.8 mm. longis, antheris transverse reniformibus 0.4 mm. latis, rima transversa dehiscentibus; ovario 3-lobato 3-loculari, ovulis in quoque loculo 2 superpositis axi affixis; stylo brevi crasso (0.2 mm. longo), stigmate 3-lobato, lobis oblongis recurvatis bilobis, staminibus alternis; drupis ovoideis, maturitate 3–4 cm. longis et 2–2.5 cm. latis, pericarpio lignoso 4 mm. crasso, extra rugosissimo, 3-locularibus (loculo 1 interdum obsoleto), disseptis coriaceis; semine in quoque loculo solitario nigrescente.

Type, *Krukoff 1454*, collected Nov. 25, 1931, on varzea land along a creek near Tabajara, upper Machado River region, State of Matto Grosso. The plant is locally known as "Goapeua." It is a species of the Section *Tontelea* Miers, in which it is related to *S. Miersii* Peyr. and *S. corymbosa* Huber. From both of these species, *S. mauritioides* is distinguished by its larger leaves of more coriaceous texture and its slightly smaller flowers. The fruit of the new species is very characteristic, bearing a superficial resemblance, in size and texture of pericarp, to the fruit of the palm *Mauritia flexuosa* L. f. The fruit of the two allied species above mentioned is not known. *S. Miersii* was placed by Miers[1] in the genus *Clercia* (*C. micrantha*), but since the distinction between *Clercia* and *Tontelea* is based upon fruit characters, it is likely that Peyritsch's treatment of the species[2] is correct.

(to be concluded)

[1] Trans. Linn. Soc. 28: 379. 1872.

[2] Mart. Fl. Bras. 11. 1: 147. 1878.

INDEX TO AMERICAN BOTANICAL LITERATURE

1930–1932

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

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